THE PSYCHOLOGY OF THINKING

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The Psychology of Thinking

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TO

ALBERT C. HILL, Ph.D.

Department of Public Instruction, Albany, for many Years Principal of Cook Academy

AND

REVEREND SPENCER FISHER

Montour Falls, N. Y., both Lovers of Boys, Character Builders, Men who have Considered it more worth while to be Makers of Men than Makers of Money.

PREFACE

The theme of this book has its origin in the fact that the writer was once a teacher of mathematics in a New England Academy. In mathematics, perhaps more than in some other subjects, the teacher who would succeed is forced to get into very close touch with the actual mental processes involved in thinking as it goes on in specific concrete cases. It was the clinical interest in the thinking process, sharpened and further developed by the teaching of mathematics, which led the writer ultimately to specialize in the study of Psychology and Logic. This original clinical interest in the mental processes, I hope, has not been lost as the result of the greater perfection of theory incident to the university course.

The reader may find the mathematical interest protruding itself at times, particularly in the choice of illustrative material; but I hope that he will not find the references to mathematics offensively frequent as compared with the references to other subjects. Indeed, many of the illustrations have been drawn directly from the most common experiences of life, entirely apart from any reference to the school.

The dominant point of view for the discussion of thinking within these covers is frankly biological. But it is biological in the broad sense. Life is not thought of as reduced to its lowest physical terms, but as inclusive of everything that makes life worth living. The life process is thought of in terms of the satisfaction of needs in the case of man as we know him at his present level of evolution and civilization. The concrete life of the individual includes all that we regard as of value, or worth while, in the complex life of the highly evolved, socialized, and civilized human being. The

attempt has been made to show the actual working of the mind as it struggles with problems in the concrete life of the individual, the significance of the mental processes when they are brought to bear upon these problems, and particularly *the growth in control over the forces of the world and of life that comes through the development and perfection of the higher psychical processes which we designate under the head of thinking.* In this discussion the emphasis falls upon the psychological rather than the logical aspect. The dynamic aspect of the thinking process has been thrown into as bold relief as possible. Questions of function and significance are central in the discussion of all the various phases of the thinking process.

While the movement of thought is dominantly psychological, the whole book is written from a strong pedagogical bias. The significance for education, and also for the teaching process, of the psychological facts and principles is pointed out. This does not mean that educational theory has been worked out in detail, but rather that the educational bearing of the doctrines set forth has been indicated and, in many cases, illustrated to make it more intelligible. The writer has attempted to make the psychological doctrine herein presented stimulating and suggestive both to the parents and the teachers of children.

The first few chapters may prove to be a little harder reading than the others for those who are not specialists. I advise that they be read rapidly for the general movement of thought, without worrying too much about their perfect understanding. They are sure to clear up as the thought is further developed and applied in the more detailed and concrete discussions which follow. Afterwards, it may be well to reread the earlier chapters. They are introductory and fundamental in character; and, while they are elaborated rather fully for introductory chapters, yet they are necessarily condensed more than would be the case in a book devoted exclusively to general psychology. In other words,

the writer has had to presuppose some familiarity with the simpler facts and principles of psychology.

References have been given only to a few books, those which are of most immediate value to the reader in amplifying, or helping to interpret, certain topics which fall within the limits of the discussion. These references are usually quite specific. It has not been my purpose to give a bibliography so much as it has been to give a few selections of the best and most relevant material. It has been presupposed that the general reader will not care for voluminous references, and that the specialist will easily help himself anyway. The selection of references has been made also with some regard to what is most probably easily accessible. For this reason, I have given no references to James' *Principles of Psychology,* but only to his *Briefer Course* and his *Talks to Teachers,* which are more widely in use. Likewise, while I acknowledge personal indebtedness to Dewey's *Studies in Logical Theory,* to Baldwin's *Thought and Things,* and to Hall's *Adolescence,* I give no references to these works.

The point of view of this discussion of Psychology in general and of Thinking in particular was formulated and the main features of the outline were sketched four or five years ago in connection with the teaching of courses in Psychology and Pedagogy in the Normal School. Most of the material has been actually used in some form in my own classes. The impetus to elaborate and publish this material was suddenly checked by the appearance in rapid succession of O'Shea's *Education as Adjustment,* Angell's *Psychology,* and Horne's *Philosophy of Education,* all of which are written from a more or less explicitly biological point of view. My present discussion must, of course, be indebted to these works for much of suggestion and stimulus. Yet it seems as if there is still room for another psychological and educational discussion involving a similar point of view, but independent of these in its specific field. The essential

features of this presentation were given in lectures at the College of Education of the University of Chicago in the summer of 1907. The cordiality with which the class received these lectures has served as the inspiration and the excuse for putting them into a more permanent form and presenting them to a larger audience.

I cannot send this little book out without recognizing my obligation to Prof. John Dewey for the large number of "seed" thoughts which have come from his lectures on Logic, Ethics, and Education. But the particular applications, developments, and formulations of these ideas, as well as the underlying movement of thought, are my own; and I alone must be subject to whatever criticism they may deserve on account of their defects. I am indebted for valuable suggestions to my colleagues, President Charles McKenny and Professor Herman C. Henderson, of the Milwaukee State Normal School, and also to Professor W. W. Charters, Ph.D., of the University of Missouri, who were kind enough to read my manuscript before its final revision.

Irving Elgar Miller.

State Normal School
Milwaukee, Wisconsin
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THE PSYCHOLOGY OF THINKING

CHAPTER I

THE BIOLOGICAL POINT OF VIEW

1. General Meaning and Significance of Thinking

(1) Thinking an active and constructive aspect of consciousness.

We all know in a general way what we mean by thinking, although we may never have taken the trouble to analyze and formulate that meaning precisely. We know that thinking is the most active and constructive aspect of consciousness. When we think there is more or less concentration of attention, and the attempt is made consciously or unconsciously to exercise some control over the movement of our ideas. In thinking we do not take our ideas merely for granted; we question them, judge them, and try to determine their value and relevancy with reference to some end. They undergo more or less of a process of construction and reconstruction. Ideas do not merely flow in a thinking process, but they are selected, rearranged, and ordered according to some purpose.

We shall not at this time attempt to define thinking. We shall content ourselves for the present with saying that what we mean in general by thinking is this active process, with which we are familiar, of going over our ideas, rearranging

[1] See advice to the reader in the Preface.

them, and ordering them to meet some need that cannot be met by the more spontaneous and undirected flow of ideas.

(2) Thinking relevant to need.

We all know, too, in a general way what is the significance of thinking in human life. We find that when we "stop to think" it is in order that we may the better deal with some situation which confronts us. This may be a situation which demands some overt action which cannot be escaped, and we think in order to determine more accurately the nature of the situation and the kind of action which is most appropriate. Again, the situation may be one which demands not immediate action, or even any specific act, but rather the formation of some attitude of mind which shall affect indirectly many of our acts thereafter, as for example a principle in politics or in religion. Or the situation may be one which demands the solution of some problem of thought which cannot be left unsolved without making the mind restless and dissatisfied. Such a case would be a theoretical problem in mathematics or a puzzle, the outcome of which is felt by the individual who undertakes its solution to have no practical value, yet he cannot be contented to lay it aside with the thought that it is insoluble or that he has not the power to solve it.

Now the point which we wish to make clear is that thinking is not normally a process which finds its justification in itself. On the contrary, it takes place in response to a need of some sort, and it is calculated to meet that need. We stop and reflect, going back over our ideas, reconstructing and rearranging them, and seeking to bring them under control in order to apply more adequately the results of our past experiences to the control of present situations in our lives.

(3) Thinking has a life function.

Thinking is not a luxury of the human race merely to be enjoyed or to be admired as a mark of special superiority. It has normally a practical value for life at some point,

securing results that cannot be secured without thinking. It is primarily something which has an important function to perform in furthering the life and interests of those who think. In the struggle for existence and for a life higher than mere existence, a life filled with those values which make existence worth while, thinking is the most central and significant of the conscious processes which contribute to that end. It is the factor to which is due in largest measure the free and flexible control of man over his environment.

(4) The functional and biological interpretations of thinking.

The point of view which has just been briefly sketched is both functional and biological. When we interpret the thinking process in terms of what it does, in terms of the precise office which it performs in the whole scheme of conscious processes, we are taking a functional point of view. When we discuss it from the point of view of its significance to life and try to analyze its place as a factor in the higher evolution of species, we are taking a biological point of view. It can readily be seen that the biological point of view in psychology, if worked out consistently, must include the functional point of view.

What has just been said must not be thought of as a complete, or even a technical, statement of the functional and the biological points of view in psychology. There has been no intention of giving definitions, but only of giving some preliminary idea, vague though it must necessarily be, of the psychological bias of this book. Just what the biological point of view means can best be understood in the light of further discussions, and its significance for psychology and education must be gathered little by little from the book as a whole. In taking the biological point of view for the discussion of the psychology of thinking, we are putting ourselves in line with a very strong present tendency about which something ought to be said.

2. Present Tendency in Psychology.

(1) Increasing prominence of the biological point of view. Perhaps the most marked present tendency in psychology is to be found in the fact that the biological point of view is coming very rapidly to dominate psychological thought. While this tendency is not in itself new, yet it is so new in its thoroughgoing and systematic application to this field that it hardly seems wise to undertake to discuss the psychology of thinking from the biologial point of view without first devoting some considerable space to its bearing upon psychology as a whole. It is hoped that the reader will be helped by this in the long run, even though he is to be delayed for quite a long time in the matter of the main discussion, that of the thinking process.

Present tendency in psychology is the culmination of quite a long period of development. Psychology has for several decades been moving away from its connections with philosophy, or metaphysics, and has been trying to ground itself upon the basis of natural science. This tendency has expressed itself very fruitfully in the powerful impulse to conduct experiments in the realm of physiological psychology, and it has given rise to the psychological laboratory as a permanent feature of all institutions which attempt to engage in psychological research. There has accompanied these two related movements a rapid growth of interest in the genetic and functional aspects of mind. This whole group of tendencies has involved implicitly the standpoint of modern biology. Yet it is not until quite recently that the biological point of view has been put forward definitely and explicitly as a thoroughgoing principle for the correlation, organization, and interpretation of the facts of mind on a natural science basis.

(2) Present view compared with Spencer's.

Our statement regarding the recency of the thoroughgoing application of the biological point of view to psychology may seem to the reader unfair to the work of Herbert Spencer.

But, while Spencer's work was of very great significance in reënforcing and giving emphasis to the scientific point of view, his treatment of psychology was vitiated by the doctrine of associationism which he borrowed from the English philosophy.

Associationism and the biological point of view in psychology cannot keep house together. Spencer's psychology, vitiated by the doctrine of associationism, could not be truly biological. Associationism represents an atomic view of mind.[1] Elements in the form of separate units of sensation are the starting point, and all higher forms of consciousness are but differing combinations, aggregations, or complexes of these elements. The biological conception is one of growth and of development marked by gradual differentiations of structure. When the structure has become complex, all parts are still functionally and organically related to one another and to the whole. There never were simple units with which to begin. The simple sensations of the associationists are not primary elements of mind at all. They are rather themselves differentiations of structure which have come about in the growth and development of the mind, and they have specific functions to perform in this more complex and more fully developed mind. Spencer's psychology and the more recent formulation in biological terms agree, however, in this respect, namely, that they are both attempts to apply to psychology the evolutionary point of view which has been so fruitful a working hypothesis in other lines of interpretation and investigation.

3. Influence of the Theory of Evolution.

(1) Nature of this influence.

Whatever one's particular view may be regarding the origin of species, one great fact cannot be escaped, namely, that the theory of evolution has profoundly influenced methods of investigation in almost every field of scientific research.

[1] Stout, *Manual of Psychology*, pp. 106-116. James, *Psychology*, Briefer Course, pp. 151, 244.

A new spirit and a new method have been introduced into all biological and quasi-biological sciences. As a result these sciences have become less classificatory in character and more historic, genetic, and dynamic. There is relatively less stress thrown upon facts of structure and more attention is given to questions of process, of development, and of function. In so far as it is true that facts of structure are studied just as much now as formerly, it is from a different point of view. Both facts to be studied and the method of their organization are determined by reference to their *relation to the life process* and its clearer and more intelligible interpretation and exposition.

(2) Illustration from botany.

In the older type of botany, the emphasis fell upon facts of structure and classification according to structure. Specimens were collected, examined, analyzed, and finally classified. The attempt was made to discover the most characteristic features of plants, those features by which any particular kind of plant could be recognized when found again. To this end, various plants which gave suggestion of belonging to the same species were carefully compared with reference to their likenesses and differences. The discovery of the most radical and persistent likenesses furnished the standard by which to group plants into classes and subclasses, so that one's knowledge of plant life could be organized into a comprehensive system, each particular fact having its own place in that system. The same method prevailed in zoölogy.

The botanist of to-day is no less concerned with the problem of organizing and systematizing his body of knowledge concerning plant life than the botanist of a generation ago. Nor do we mean to imply that he does not care at all for the facts of structure. But the chief stress of his investigation falls in a different place, and he employs a different method of organization. He cares less for that group of facts which is the result of observation and analysis of fully

developed forms and more for the whole group of facts connected with the growth and development of plants. In other words, he studies living things less in cross section and more in their continuity. He raises questions about the physiological processes concerned in the maintenance of the life of the plant. He also wants to know about the functions of its various parts. What special work do the roots perform? What do the leaves contribute? etc. Every fact of structure is viewed as having some probable significance. Concerning it we must raise the question of why? or what for? and also, how did it come to be? It is not a mere fact, however interesting a fact it may be as such, but it is a fact with a history and with a meaning. What is that history? and what is its meaning in the life of this plant-form?

From this point of view, everything that in any way serves as a modifying condition is relevant, and its study in relation to the life of the plant is necessary. The botanist, then, inquires into the conditions favorable and unfavorable to the growth and development of the plant. But he also goes farther than this in his interpretation. He tries to find out about any particular form of plant not only the facts of its present life, but also what is its ancestry. Still further, he seeks to learn under what conditions, by what process, in accordance with what laws, it has evolved from more primitive forms. If he finds two plant-forms having a common ancestry, descended from a common stock, even if they differ quite widely in many of their external characteristics, he puts them in the same general class. The method of his investigation and the organization of his material are both dominated by the concept of evolution.

(3) Illustrations from other sciences.

Not only the immediately biological sciences of botany and zoölogy have been determined in their method and in their evaluation of fact by the theory of evolution; but also the indirectly biological sciences of history, political science, economics, and sociology have undergone pretty thorough

reconstruction under the influence of the same controlling idea. The events of history are not mere events, but they are events to be studied, interpreted, and organized with reference to their relation to human progress. Political and social institutions are viewed as having arisen in the gradual process of attaining better adjustment between social groups and their environments; and the significance of these institutions is to be determined by the value which they have had and are having in the perfection of such adjustment. The dynamic aspects of these sciences are receiving more and more attention. They are less static and abstract, and are becoming more dynamic and concrete. Life, action, process, movement, function, interconnection, law, wholeness, organic relationship are emphasized. Even theology, which seems most of all to deal with absolutes, is bowing to the demand for reconstruction along lines which make it more in harmony with the other sciences, and religion is being viewed as a phenomenon whose great value consists in its vital relationship to the problem of the most complete adjustment in thought and in action to the wealth of social and spiritual values in man's environment.

(4) Application to psychology.

Now the point of all this discussion is to make clear and meaningful the statement that psychology is feeling the influence of this same type of thought. Psychology is seeking to express itself in biological terms, in terms of the problem of adjustment. This is not at all strange when we think that mind as we know it is a characteristic of *living* things. Consciousness isolated from the living thing which is conscious is an abstraction. We know of no such thing as consciousness in general; there are only individual consciousnesses belonging to individual living things. The human being is not different in this respect from other living creatures, even though he is characterized by a higher order of mind. As a living being he is a proper subject of study for the biologist. But he is more than a material

organism; he is an organism with a mind; he is a psychophysical organism. Here the problems of biology and psychology meet and interpenetrate by virtue of the very nature of man. Who then shall separate them without doing violence to the truth? It is certainly more natural and more reasonable to associate psychology with biology than with philosophy.

The reality of the facts of consciousness can be gotten at only by studying it in its setting of life activities. The study of consciousness in cross-section, the analysis of mental processes in terms of their structural differentiations, is not adequate. We must raise the further question of the function and significance of every aspect of consciousness in the life of the whole. That whole is itself not static, but it has come to be what it is as the result of a process. Is consciousness in any way subject to the law of that process? Has consciousness any significance in it? Are there conditions in the lives of evolving organisms which call for the emergence of the various activities of consciousness in order that the situations which confront these organisms may be satisfactorily met? What are these conditions? Just how do special conscious processes become differentiated and organized into forms of mental action which are adapted to meet them? Such problems as these arise the moment we try to apply the method of evolutionary science to the study of consciousness. Psychology, like the other sciences that we have discussed, then becomes vital, dynamic, and functional in character.

This line of thought will clear up still further as we proceed. We shall now try to get at it and give it further development through the analysis of the conception of an organism.

Before proceeding to the next chapter, however, it may be well to caution the reader against the common materialistic misinterpretation of present day psychology. The psychologist, in limiting his discussions to those conscious

powers or processes which he finds, or of which he finds evidence, in the lives of mortal individuals between the limits of birth and death, *neither affirms nor denies* the existence of any other aspects of mind than these. He purposely limits his field of investigation to the facts of experience here and now. The empirical field is large enough and worthy enough of separate treatment. From this point of view, the problems of the immortality of the soul and their like belong to the field of the psychologist no more than they do to that of the physiologist or the astronomer. The psychologist, however, in excluding these problems from his discussion, does not necessarily do so on the ground that their study would not be of great value or that some solution justifying faith in the unseen is not possible. His legitimate reason for refusing to discuss these problems is that their solution would require a *different method of procedure* from that employed in dealing with the empirical facts of mind, and he wishes to get together under the control of the principles of one science all the facts the investigation of which *falls under a common method.*

Supplementary Readings for Chapters I and II

Angell, *Psychology,* Ch. I.

Angell, "The Province of Functional Psychology," *Psy. Rev.,* March, 1907.

Bagley, *The Educative Process,* Ch. I.

Horne, *The Philosophy of Education,* Ch. II.

James, *Talks to Teachers,* Ch. III.

O'Shea, *Education as Adjustment,* pp. 44-51, 76-93, 99-104.

Stout, *Manual of Psychology,* Bk. I, Ch. III.

Sully, *Teacher's Handbook of Psychology,* pp. 46-47, 77-85.

CHAPTER II

THE BIOLOGICAL POINT OF VIEW
(CONTINUED)

1. GENERAL NATURE OF AN ORGANISM.

An organism is quite commonly thought of as something which is complex in structure and possessed of well-defined and distinct parts or organs. But we call every independent living thing an organism regardless of the degree of its complexity. Bacteria, consisting of single cells microscopic in size, are organisms. The stalk of grass, the flowering plant in the window box, the pumpkin vine, the oak of the forest, these all are organisms. All forms of animal life, too, are organisms. The amœba, which is only a tiny drop of protoplasm, the minutest insect, the angleworm, the oyster, the bird, the elephant, the human being, these are all organisms.

From the illustrations given it is evident that some organisms are very simple and some are very complex. It is true that most of the organisms to which our attention is commonly drawn are complex and it is possible to discern in them differentiations of structure for the performance of special functions. But is such differentiation of structure an essential characteristic? or is it the means to a better realization of functions? Evidently the latter. While we see that an organism is some sort of a living whole, we must look deeper yet for its absolutely essential characteristics.

2. ESSENTIAL CHARACTERISTICS OF AN ORGANISM.

If we keep our illustrations in mind, we can see that the essential characteristics of an organism are as follows:

(1) When an organism is complex, no one part is an end in itself for the sake of which the other parts exist as mere means to that end.

Every part of an organism has its function to perform, and the value and significance of that function are to be determined by reference to the part which it plays in the life of the whole. It is not for the sake of the leaves alone that the roots of a plant exist and perform their function, nor for the sake of the stem that the leaves exist. But each one,—leaves, root, and stem,—has its function to perform in the maintenance of the whole plant of which each one is a constituent part. Not even the seed or the fruit is an end in itself, though from man's point of view it may seem to be so. From the biological point of view the function of the seed is merely to perpetuate and propagate this particular kind of plant life. In like manner we may say of every organ or part of the human body, such as heart, lungs, teeth, muscles, nervous system, etc., that no one of these is an end in itself for the sake of which the others exist and perform their function. Each one exists to perform some function which enables the whole organism to maintain itself upon the earth better than it could without this organ. The relation of parts within an organism is sometimes expressed in this way: Every part of an organism is both means and end to every other part.

(2) The organism is a self-maintaining system; it possesses all the functions necessary to the maintenance and perpetuation of itself.

A stone cannot be said to be an organism; it is not a self-maintaining system. While suffering from the disintegrating influences of the environment, it has no specific method determined from within itself of making up its losses. But the plant is constantly taking elements of moisture and nourishment from the soil and carbon dioxide from the air to make up for losses sustained by evaporation and excretion.

(3) The organism is characterized by a law of determination from within.

In the case of the stone, its size, shape, etc., are deter-

mined by no specific inner law, but by external forces. But the plant and the animal, while modified in many respects by the influences of the environment, are nevertheless expressions of some more or less specific inner law of development. Plant a bean and you expect a vine of about a certain height, size, and shape, with leaves and stem marked by well-defined characteristics, and blossoms and seeds which you can describe in advance of their appearance. Plant an acorn and you expect an oak with all that is characteristic of that monarch of the forest. Hatch a hen's egg and you expect a chicken and not a hawk. In all these cases there is a specific law of development which no amount of external force can set aside, however much it may modify the final resultant.

3. ADAPTATION BETWEEN ORGANISM AND ENVIRONMENT.

(1) Meaning of adaptation.

a. Activity of external factors.

We have spoken of the organism as a self-maintaining system, characterized by a law of determination from within. Before we can see clearly the function of consciousness in the life of the organism, we shall need to develop a little more fully the meaning of this statement. In the first place, we must not suppose that any organism is *wholly* determined from within. There are also significant forces of the environment constantly acting upon it. These may be favorable and necessary to the life of the plant, if plant it be, or they may be unfavorable to its development, and possibly even destructive. The plant requires from the environment light, heat, moisture, elements of nutriment, etc. To be sure, some one of these may be present in such intense form, as is often the case with heat, that the life of the plant is destroyed. But, take any one of them away, and the plant must perish in spite of all its inner tendencies. We see, then, that the life of the plant depends upon the existence of a constant stream of external influences which affect it in various ways.

b. Activity of internal factors.

In the second place, when we turn to the other side of the question for a moment, we can see that the law of determination from within is the very real expression of inner forces which have to be taken into account. The rock and the plant may be surrounded by the same external forces, but they are *affected* differently by them. The plant has a way of responding to certain of them which results in life and growth. Again, two plants grown side by side and subject to the same set of external conditions may differ as widely as the rose and the cabbage. While it is true that the external conditions are necessary, it is evident that the *form* of the plant is due to something other than these factors. It must be due to the operation of a law of determination from within.

c. Interaction between external and internal factors.

Our analysis has tended to make clear the fact that the life process involves two sets of factors, the outer and the inner. Life and growth are dependent neither upon the one set nor upon the other exclusively, but upon the coöperation of the two. A bean may be kept away from the moisture for a year or more and it will not develop. It needs this influence from the environment in order to "realize" itself. But when it is supplied with the proper external conditions to induce growth, its growth will be in harmony with the inner law of its own development. The materials will be organized into a characteristic form of life the stages of whose development and the leading characteristics of which we can predict. Our illustrations have been drawn from plant life, but the principle is the same for animal organisms. The life, growth, and continued existence of the organism, whether plant or animal, depend upon the proper *interaction between internal and external factors.* So long as there is preserved the proper equilibrium between these two sets of factors, so long as they coöperate with each other, the life process goes on, and we have a self-

maintaining system, or organism. Destroy this equilibrium and the organism will soon come to an end.

d. Further interpretation of organism and of adaptation. It is, then, a fundamental biological fact that the life process depends upon the proper interaction between inner and outer factors in some center for their coördination. Such a center we call an *organism*, and the process of right coördination we call *adaptation*. From the point of view of the biologist, then, an organism is a center for the coördination of inner and outer forces in such a way as to further the life process, and, in turn, this furthering of the life process is adjustment, or adaptation.

(2) Law of reaction.

If we speak of the interaction between organism and environment primarily from the point of view of the part which the organism as an already organized structure plays in it, we call the process one of reaction. As the psychologist is interested in the organism and its conscious processes directly and only indirectly in the environment and its forces, he uses the term reaction instead of interaction.

The relation between the inner and the outer forces in the life of the organism may be formulated in simple terms somewhat as follows: *The life and development of the organism depend upon the proper reaction of the inner factors upon the outer,*[1] *the outer serving both as stimulant, or excitant, and as means, or material.* Thus, food is to the animal both an excitant calling forth some reaction on his part, and it is also material selected from the environment to be used in the maintenance of the life of the organism.

The law of reaction has been formulated in most general terms applicable to all organic activity as follows: *"All stimulations to living matter,—from protoplasm to the highest vegetable and animal structures,—if they take effect at all tend to bring about movements, or contractions, in the*

[1] Sully, *Teacher's Handbook of Psychology*, pp. 77-85.

mass of the organism."[1] Mr. Baldwin calls this the law of dynamogenesis. More briefly stated it is as follows: *"Every organic stimulus tends to express itself in movement."* Thus the tiny amœbæ, unicellular organisms in the form of minute droplets of protoplasm, are capable of responding in characteristic ways to the presence of light and food. Even the plant bends toward the light. The lives of the familiar animals furnish illustrations without number of the operation of this general law, which the reader can easily supply.

(3) Function of reactions.

The biologist views the organism as a device for the execution of movements in response to stimuli. This capacity of the organism is fundamental to its very nature. It is only through reactions that adaptation, or adjustment, is effected between organism and environment and life is maintained.

From the biological point of view every form of life that *can* maintain itself has a right to live. The weed and the snake may not for us, and from our purely human point of view, have any value or subserve any end. But we may not inject our limited point of view into the biological process. Nature is "interested" in every one of her living forms. Hence the primary and fundamental end of every organism is self-preservation and perpetuation of its kind. We have seen that this can be secured only through the proper interaction between the inner forces of the organism and the outer forces of the environment. These must come into some sort of working terms with each other. There must be adaptation of the one to the other; there must be adjustment between them.

Every organism is, then, "seeking" to realize itself through a process of adjustment between itself and the conditions of its environment. This process is effected through reactions. This is as true for the organism with a mind as

[1] Baldwin, *Mental Development,* pp. 166, 170.

for the one without any conscious processes. We can determine whether an organism is high in the scale of development only by a study of its modes of reaction in their relation to the problem of attaining the most advantageous forms of adjustment between organism and environment. The mind is a factor in the solution of that problem.

4. The Biological View of Mind.

Our study of the characteristics of an organism and the process of adjustment has prepared us to understand what we mean by a biological view of mind. If we take the biological point of view in psychology, we start with the living whole, with the organism. That living whole is psycho-physical. The human being cannot be described wholly in terms of body, nor can he be described wholly in terms of mind. Both are essential; he is a mind-body creature. This is a fact which we cannot overlook in our interpretation of the mind. Consciousness and all its processes must be described in terms of the living whole,—the psycho-physical organism. We can best show what this means by pointing out certain psychological principles, which, from this point of view, follow from our analysis of the organism.

(1) Consciousness not an end in itself.

From the biological point of view, *consciousness cannot be viewed as an end in itself* any more than the hand and the stomach can be viewed as ends in themselves. The psychological aspect of the organism cannot be fully understood by studying it in isolation, in terms of itself. Psychology must show the use, or function, of consciousness in the life of the whole psycho-physical organism,—the part that consciousness plays in the concrete life of the individual. Psychology cannot profitably study consciousness in the abstract, apart from any relation that it has to the body, or that the body has to it, apart from the complex of activities, or reactions, in which it inheres and which form its natural setting.

(2) Mental processes have adjustment value.

As the organism is a self-maintaining system, *the mind and its various forms of activity have some specific relation to the self-maintenance and perfection of the organism.* Every mental process has a place and a function within the whole organic system. The biologist believes that every special structure has arisen in the process of adjustment, or that having appeared as a variation it has been preserved and perfected because of the advantage which its possession has given to the organism in the struggle for existence. He has thus come to view every differentiation of a structure as having some special adjustment value secured through a useful correlative specialization of function. The mind and its conscious processes are not to be excepted from the general principle. Mind must have some significance in the process of adjustment. The question then becomes, What is that significance? Under what conditions of reaction would conscious processes be advantageous? That is, in what sorts of situations would they have selective value and be at a premium in the struggle for existence, or for a more satisfactory existence? Just what is the function and the adjustment value of each of the various differentiations of consciousness,—the various attitudes of mind and the various mental activities? Just what part does each play in the process of more perfect adjustment? What in detail is the *method* by which each of the various conscious processes contributes to the maintenance and welfare of the psycho-physical organism?

Take the case of memory for example. Psychology will raise such questions as these: Under what conditions will the activity of mind need to assume the form of memory? What will be the use of memory when it does appear? Just what does it contribute under this particular set of conditions to the solution of the problem which confronts the organism? What is the method of its operation in the performance of its function? What are the specific ele-

ments of technique involved in that method? What is its relation to the other conscious processes involved at the same time or in connection with the same situation? Thus memory will be studied in its whole setting, which includes its relation to bodily activities, or reactions, which are producing, or are tending to produce, changes in the environment or in the self. Psychology, from the biological point of view, will take the same attitude toward all the other conscious processes,—whether they be classed under the heads of intellect, feeling, or will. They will all be regarded as functional activities of the mind called forth under conditions which make them necessary in order to meet specific needs of the whole organism.

(3) Law of human self-determination psychical as well as physical.

As a law of determination from within is a fundamental characteristic of the organism, it must be that *in the case of psycho-physical organisms the law of self-determination is psychical as well as physical.* The kind of organism is that which is characterized by both body and mind in organic relation to each other. When the biological view of mind is urged, its advocate is often thought to be making the body and its physical life the end, viewing mind and all its processes as mere means to that end. But mind, when it appears in the living organism, becomes a part of the whole, an integral aspect of the self. The self is incomplete without it. Psychical dispositions and tendencies of every sort, both native and acquired, are inner factors just as really as bodily tendencies. And adjustment to environment in case of psycho-physical organisms must be such as to satisfy needs springing from the mental constitution of the individual as well as the physical.

The point which has just been made regarding the mental life also holds true with reference to the social nature. The law of determination from within in the case of human beings includes social tendencies which are inherent.

Aristotle said that man is a political (social) animal. There have been schools of thought which attempted to explain all social organization from an individualistic and selfish basis. But modern psychology and sociology agree with Aristotle that there is something inherent in man's nature responsible for the evolution of social organizations. There is some sort of a push-from-behind which must be taken into account as well as special conditions of the environment in explaining the varied social institutions of humanity. The same thing is true in the case of the moral and religious life and their forms of expression.

In treating, then, of the higher forms of organisms which have found their culmination in the human species, when we speak of adjustment between organism and environment, we shall mean by environment not merely physical nature but every form of influence from without the individual which comes into interaction with his inner tendencies. As inner tendencies are physical, mental, social, ethical, religious, etc., man's adjustment to the world in which he lives is not complete except as it is effected in terms of processes which shall meet his various classes of needs, needs that are inherent in the very nature of his law of determination from within.

5. Conclusion.

From the biological point of view, we regard consciousness as an essential characteristic of the human organism, which has developed to its present stage of specialization and efficiency in the process of more adequately meeting human needs. As needs have multiplied and have become more definite and highly specialized, consciousness has evolved more fully and has taken on specialized modes of activity relevant to the meeting of these needs. The consciousness of the human being is higher than that of the rest of the animal world not so much by virtue of the fact that he has to adjust himself to a more complex environment, as we sometimes hear it stated, as by virtue of the fact

that he has evolved a more complex and varied set of needs, —physical, mental, social, ethical, religious, aesthetic, scientific, etc. To satisfy these needs man is impelled to put himself into more complex relations with his environment. His adjustments in the attempt to meet these needs are more varied and complex. This calls for a higher order of conscious processes.

Among these higher conscious processes, one of the most significant is thinking, of which we are to make a special study. But before we can enter upon the details of this investigation, we shall have to pause for some length of time to develop more fully our point of view for the interpretation of the facts which we shall discuss and for their organization into one consistent whole. This will make necessary some considerable preliminary study of the function of consciousness in general and of the manner in which it becomes differentiated, specialized, and more highly organized for the more efficient performance of its function.

CHAPTER III

THE SENSORI-MOTOR CIRCUIT

1. Need of more detailed Study of the Reaction Process.

If consciousness is to play any part in the concrete life of the individual, if it is to have anything to do with adjustment, then it must have some place within the reaction process. From the biological point of view we must, then, determine just where consciousness comes into the process of reaction; also under what conditions and with what sort of function. This cannot be done without taking account of some important principles of nervous action.

2. The Reaction Process in Terms of the Sensori-Motor Circuit.

We shall call the course which a nervous impulse takes from the time that it originates in some sort of stimulus affecting a sense organ until it results in some sort of muscular movement, a sensori-motor circuit. The reaction process properly includes the whole set of activities involved in the completion of a sensori-motor circuit. It has its sensory phase, including stimulus and ingoing nervous impulse; its phase of central redirection in the spinal cord or the brain; and its motor phase, including outgoing nervous impulse and muscular movement, or response. Consciousness, if it comes in at all to modify reaction, functions only in the phase of central redirection, and here only when this redirection takes place in the higher centers of the brain known as the cortex.

3. Number of Types of Sensori-Motor Circuit.

The most casual student of the nervous system must know how exceedingly complex it is and how intricately its minute elementary structures, the neurones, connect with one another. It must be expected, then, that in the varied reactions of the complex human organism innumerable sensori-motor circuits are involved. However, we may roughly reduce them to three general types. These may not be adequate in the explanation of all the details of reaction, but they will help us to reduce to some sort of intelligible system the bewildering complexities and intricacies of nervous action.

4. The Use of Diagrams.

(1) Cautions against their misinterpretation.

In explaining the three general types of sensori-motor circuit, we shall be greatly aided by the use of diagrams. But we must keep constantly in mind that the diagrams employed in the explanation of the activities of the nervous system cannot represent facts of detail; they can only schematize the most general principles. The diagrams which follow are highly schematic, and they are drawn purposely in such a way as to leave no room for supposing that they are at all pictorial in character, not even in the matter of conformity to the shape of the brain. No reference is made to the sympathetic system and its relation to the cerebro-spinal system. No attempt is made to represent the shape or the number of the neurones involved in a reaction process, nor the precise manner of their interconnection. For these facts, important as they are, the student should consult some standard text in physiology or neurology rather than expect them to be represented and discussed here. It would take us beyond the compass and purpose of this brief treatise to enter into the minute details of the structure of the nervous system. Yet certain general ideas of its method of action are necessary to

an understanding of the function of consciousness in the life of the organism. The diagrams given here will be helpful if it is constantly kept in mind that they are not intended to represent details of anatomy, but that they are intended to represent in a schematic way only certain typical *pathways,* together with certain critical points of transfer of nervous impulses, in the course of the complete sensori-motor circuit.

(2) The diagrams and their terminology.

Z represents any, or all, of the cortical brain centers.

X represents any, or all, of the lower brain centers.

B1, B2, etc., represent different levels of the spinal cord.

A1, ..., An represent stimuli affecting sense organs and setting up impulses which reach spinal cord or brain.

A1-B1 represents an afferent impulse traveling to the cord as a center; An-X represents an afferent impulse traveling from eye, ear, or other higher sense organ to lower brain center without going by way of the cord.

B1-C1, B2-C2, etc., represent efferent impulses traveling out to muscles.

C1, C2, etc., represent muscular responses.

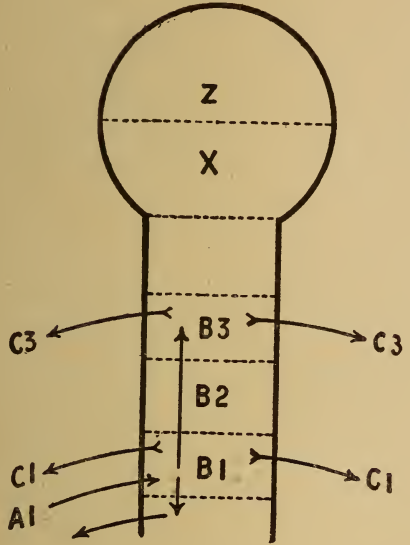
The dotted cross lines are for schematic convenience only.

5. First Type of Sensori-Motor Circuit. (See Diagram I).

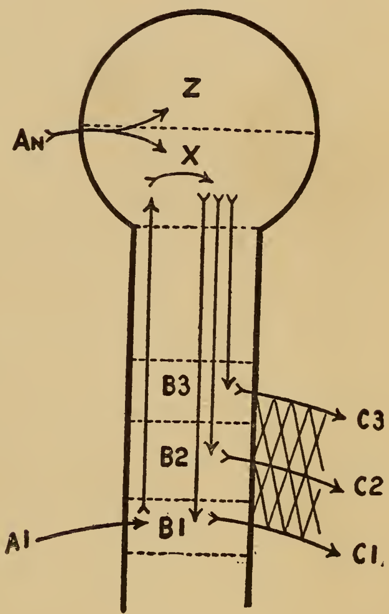
(1) Definition.

In this type of sensori-motor circuit the transition from sensory to motor phase, or the central redirection, is effected in the spinal cord or in the medulla, an enlargement of the spinal cord at its upper extremity. The first type of circuit represents, then, the pathway of a nervous impulse from sensory excitation to motor response by way of the spinal cord or the medulla. The characteristic method of reaction corresponding to this is commonly called reflex. Illustrations of reflex action with the center of redirection

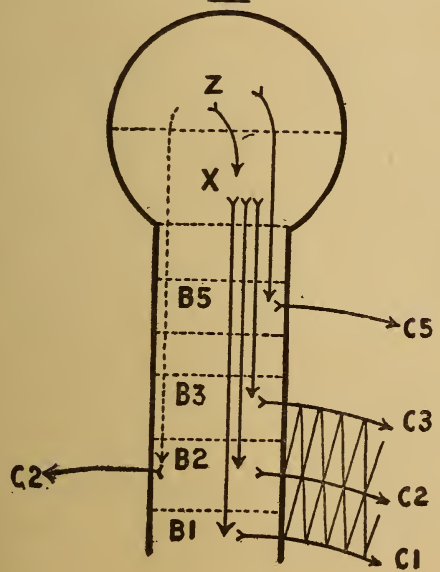
I


Z
X
B3
C3
C3
B2
C1
B1
C1
A1

II


Z
AN
X
B3
C3
B2
C2
A1
B1
C1

III


Z
X
B5
C5
B3
C3
C2
B2
C2
B1
C1

in the cord are to be found in such cases as the sudden withdrawal of the hand from the prick of a pin and the movement of the foot of a sleeping person when it is tickled. The medulla is the center of redirection for the so-called "higher" reflexes, such as winking, sneezing, coughing, vomiting, swallowing, etc. These are not to be confused with automatic actions, such as breathing and beating of the heart, which are also controlled by the medulla in large part.

(2) Reference to the diagram.

In the diagram we have illustrated only that case of reflex action in which the center of redirection is to be found in the spinal cord. A1-B1-C1 represents the sensori-motor circuit ordinarily involved in such a case. We shall suppose that it is the response to the tickling of the foot. The motor discharge would normally take place at the same level in the cord as that at which the sensory impulse is received, and it would normally go out on the same side, that is, the foot which has been tickled would be withdrawn.

It is possible, however, when there is some interference with the more primary method of response, or when it fails, for the nervous impulse to discharge from the spinal center upon the opposite side. In this case, the other foot might be used to rid one's self of the irritant. Or the impulse might even travel up in the cord to a higher level and there be discharged into a motor channel,—reflex act A1-B1-B3-C3. For example, one might with his arm sweep away a fly from his bare foot, if he were in a position such that he could not dislodge the irritant by a movement of the foot itself. In cases so complex as this, however, it is difficult to suppose that the act is wholly reflex, particularly in human beings.

(3) Significance,—mechanism for simple mechanical movements.

Whether redirection of the nervous impulse takes place

in the cord or in the medulla, the essential nature of the sensori-motor circuit involved is the same. The connection between the sensory neurones which bring the impulse in to the center and the motor neurones which carry the impulse out to the muscles is quite direct, the redirection at the center is rather immediate, and the mode of reaction is relatively simple. It has been proved by experiments upon lower animals, in which the brain has been removed or extirpated, that this lower circuit through the spinal cord provides a mechanism adequate to the performance of all the elementary muscular movements which are involved in all the activities of the animal. But when these acts are not influenced by any discharges of nervous impulse from the brain downward into the cord, in other words when they are purely reflex, they are totally lacking in spontaneity, or voluntariness, and they are as purely mechanical and necessary in character as the movements of a machine which are released by a spring or which are set free by the pushing of a button. Indeed, the figure of speech, "press the button and the machine will do the rest," would not be inappropriate to apply to acts which involve only the first type of sensori-motor circuit.

(4) Place of consciousness in this circuit.

Properly speaking, consciousness has no place within the first type of sensori-motor circuit. In reflex action, as we might expect from the immediacy of central redirection, consciousness does not intervene between stimulus and response. Hence it cannot modify or control the reaction in any respect. If consciousness does accompany the act at all, it may be explained in either or both of two ways. The nervous impulses set up by the movements of the muscles while the action is taking place may travel to the brain and we may feel the movements. That is, we may be conscious of the fact that we are winking or that we are withdrawing the hand from the prick of a pin, but at the same time consciousness has had nothing to do with the

production of these movements. Or it may be that some of the original sensory impulse responsible for the reflex act has spread upward to the brain and resulted in awareness of the stimulus, but before this has happened a much larger portion of the current has been redirected from some center in the cord and is already out on its way to produce the muscular contraction. Thus, while we know that we have been pricked by a pin, the consciousness of this fact was not responsible for the movement; for it did not come soon enough. The central redirection into a motor channel took place before the nervous current reached the centers of consciousness in the brain.

6. Second Type of Sensori-Motor Circuit. (See Diagram II).

(1) Definition.

This circuit is by way of the lower brain centers. At various lower levels of the brain there are masses of gray matter, among which are the optic thalami, the striate bodies, and ganglia in the cerebellum, the pons, and the medulla. These centers lie outside of the first circuit, but through interconnections of neurones they receive impulses from the sensory side of the first circuit and transfer them to its motor side. This longer route for nervous impulses by way of the lower brain centers through a loop, as it were, added to the first circuit, is what we mean by the second type of sensori-motor circuit.

(2) Reference to the diagram.

A stimulus originating at A1 may generate an impulse which reaches the cord at the level of B1. Instead of discharging at this level, it may travel upward to the centers at X. Now from X, pathways run down to all the levels of the cord. Hence there is this added possibility not offered by the first type of circuit, namely, that impulses may discharge from the centers at X simultaneously to touch off the responses C1, C2, C3 all at the same time,

thus combining them into one complex act. Or, the impulses may be discharged from the centers at X successively to touch off the responses C1, C2, C3, etc., one after another in some given order, thus producing a complex reaction process made up of a series of interrelated acts no one of which may necessarily have any significance in itself and yet the whole series be admirably adapted to the attainment of some useful end or the performance of some important function.

(3) Significance,—mechanism for complex, organized, mechanical reactions.

The lower brain centers, according to prevailing theory, control complex and coördinated activities of various sorts, such as the instinctive and the habitual. For the performance of this function they seem admirably adapted. From the fact that the lower brain centers may discharge into all the different centers of the cord and thus touch off several elementary motor processes at the same time or in succession, the coördination and organization of activity is made possible. But these lower brain centers may also receive sensory impulses from every sensory surface, hence we have the possibility of the most delicate coördination of every sort of sensory impression with every sort of motor response. And muscular activity may be coördinated not alone with the activities of a single sense organ, say the eye, but also with the activities of all the sense organs,—those of touch, hearing, etc.,—all at the same time or within the compass of the same situation. All the sensory impressions that are relevant in a given situation, and all the muscular movements that are useful, may work together in one large organization of activity in which they are properly adjusted to one another to make the whole method of reaction one which is very highly adaptive.

Experiments upon animals, in which the higher brain centers have been removed or extirpated, confirm the view that the control of coördinated and organized motor

processes is through the activities of the lower brain centers which are brought into play in the second type of sensori-motor circuit. Mr. James cites experiments made upon frogs in which the frog deprived of the use of his higher brain centers could perform every complex act of which the normal frog was capable.[1] He could walk, jump, turn over from his back, swim, croak, etc. But the same experiments show that the acts of this frog were perfectly mechanical. They occurred under stimulation and only when the stimulus was given. There was nothing spontaneous or voluntary about them. The frog was nothing but a complex machine. "Touch the right button" and a certain act would occur inevitably. The act might be very complex, but the complexity was one which had been already built up and established; the organization of the response had been previously perfected and had become a part of the mechanism of the animal. Such acts may be very highly adaptive, but they are nevertheless mechanical. In the lives both of lower animals and of man a very large number of the complex acts of ordinary life which are adapted to ends are of this mechanical sort produced by currents of nervous energy which take the course of the second type of sensori-motor circuit. They are modes of reaction which are instinctive and determined by heredity; or which are habitual, having been built up and perfected in their organization in the lifetime of the individual.

(4) Place of consciousness in this circuit.

In man, both instinctive and habitual acts, while they are dominantly under the control of the lower brain centers and are thus mechanical in character, are not likely to be entirely free from the determining influence of consciousness. But in many cases, as will be shown in detail in a later chapter,[2] consciousness enters only to play the part of the most organic and automatic aspects of sense

[1] James, *Psychology,* Briefer Course, pp. 92-96.

[2] See Chapter VII.

perception and associative memory. In a sort of organic fashion, as distinguished from ideational, the sense perception processes are brought into very delicate accord with motor processes in a way that is very significant for the process of adjustment between organism and environment.

7. The Third Type of Sensori-Motor Circuit. (See Diagram III).

(1) Definition.

This circuit is by way of the higher, or cortical, brain centers. These are the centers which are known to function in connection with conscious processes and voluntary action. The connection of the cortical centers with the lower brain centers forms an additional "loop." Sensory impulses transferred from centers in the cord to lower brain centers may pass upward from these to the cortex, and motor impulses may travel downward from the cortex either directly to the lower brain centers or directly to centers in the cord. When impulses originating in a stimulus to some sense organ ultimately pass through the cortical centers before they produce their muscular response, no matter how many intervening transfers of nervous energy may have been made, their route is that of the third type of sensori-motor circuit.

(2) Reference to the diagram.

In the diagram, to avoid too great complexity in one figure, we have not represented the full "loop" from X to Z and back from Z to X or to some B. We have represented only the downward, or motor, pathways. On the motor side of this circuit, it is very significant that there are two types of connection of the cortical centers with lower centers. The impulse from Z, whether it originates in other brain activities or results from a sensory impulse due to excitation of a sense organ, may discharge directly down into the centers at X, or it may discharge directly down into some center B in the spinal cord without being

redirected at X. Now, if the centers at Z discharge into those at X, then they touch off the mechanism which controls an already existing coördination of activity,—for example, the complex act represented by C1-C2-C3. But the centers at Z may discharge directly into some spinal center, say B5, thus producing the isolated or relatively simple reaction C5. Now it is evident that if Z should discharge into both X and B5 at the same time, or in immediate succession, there would arise a new complex of activity in which C5 would be combined with C1-C2-C3, making a new organization of activity C1-C2-C3-C5. Or, if an inhibiting impulse should be sent down directly from Z into B2 at the same time that X were touched off, then the muscular process C2 might be withdrawn from the coördination C1-C2-C3, and we would have the modified reaction C1-C3. The centers at Z might also play down upon different centers at X, controlling different coördinations of activity, and thus new combinations could be made of already existing complex motor adjustments.

(3) Significance,—mechanism for variation and reconstruction of reactions.

The function of the third type of sensori-motor circuit has been seen roughly through symbolic illustrations. Let us now interpret this in the concrete. It may be possible that for certain purposes the movements of the fingers of the hand are well coördinated. The coördination is already established and works smoothly. If so, the impulse from the cortex originating in a single idea may set off the whole complex of activity through discharging into the appropriate lower brain center which controls that particular coördination of motor processes. The reaction would then take place mechanically upon the mere thought of it. But suppose that there is need for the thumb to be brought into coördination with the fingers. Then additional discharges of nervous energy may be sent down from the cortex directly to the center in the cord which controls the activity

of the thumb at the same time that the discharge is sent down from the cortex indirectly to the fingers through the center of control in the lower brain. Thus coördination of the activities of thumb and fingers is brought about. When this coördination is once thoroughly mastered, its control tends to drift downward into the lower brain centers and thus to become mechanical. In like manner, through combined action of the cortical and the lower brain centers, the complex activity of walking may be modified so as to serve the purpose of propelling a bicycle. And the person who has learned to play a piano or an organ may learn to coördinate with the activity of the hands in this process also the activity of the feet in playing the pipe organ. And the child who can scribble may learn how to control the movements in such a way as to write or draw.

The significance, then, of the fact that currents of nervous energy which originate in any part may pass through the cortical centers before draining out into motor channels is to be found in the possibilities afforded of variation and change. By adding and subtracting muscular elements, or even complexes of elements, reaction processes can be indefinitely reconstructed. New coördinations can be set up and all sorts of variations can be introduced into old coördinations of activity. Thus we have in our modes of reaction spontaneity, variety, change, as over against mechanical necessity. This, of course, makes for greater delicacy of adjustment as well as for continued growth in control.

(4) Place of consciousness in this circuit.

The cortical centers involved in the third type of sensorimotor circuit include those which function in terms of conscious processes and those which function in terms of motor discharge. The significance of this will be worked out in more detail in a later chapter.[1] But it is evident from the facts of anatomy and of function stated that con-

[1] See Chapter IV.

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sciousness may enter into this circuit at the point of central redirection in the cortex. It is in the voluntary processes of organizing and controlling reactions that consciousness functions vitally in terms of all its particular forms.

8. Recapitulation and Comparison of the Significance of the Three Types of Sensori-Motor Circuit.

The first type of sensori-motor circuit makes possible all the elementary muscular movements involved in the process of adjustment, but it ties these down to a very close and immediate connection with their stimuli. The centers in the spinal cord are a sort of "keyboard" upon which incoming impulses play individually to produce mechanically every distinct kind of simple movement.

The second type of circuit makes possible organized and coördinated activity of a highly complex and adaptive character. The lower brain centers touch off certain established complexes of motor processes, either hereditary or habitual, but these then occur mechanically with little room for variation and flexibility of response.

The third type of circuit is the physiological basis of the most important power of the human organism, namely, spontaneity and variation of response. This makes it possible to meet complex and varying needs in the midst of an ever changing environment and to secure a delicacy of individual adjustment which could not be provided by methods of reaction determined wholly by heredity.

9. Unity and Interdependence of the Three Types of Circuits.

The three types of sensori-motor circuits which we have been discussing are not to be thought of as acting independently of one another. The nervous system is one complete whole of most delicately related parts. Its action is essentially dynamic. An impulse entering at any point has a tendency to diffuse rapidly through the whole system,

though the extent, or degree, of diffusion is limited by the fact that certain easier lines of discharge than others are determined by racial heredity or by habit.

In complex reactions the most remote parts of the nervous system may function harmoniously in the determination of the response. All three of the sensori-motor circuits may be employed at the same time in the reaction processes involved in what we often consider a single act,—say, for example, in batting the ball in a game of baseball. The successful hit calls for the most delicate coördination of the eye-activities and the muscular processes involved in swinging the club into the right position. Sense judgment and motor reaction are practically instantaneous and automatic at the moment that the ball leaves the pitcher's hand. But this same reaction involves cortical activities with their accompanying thought processes in taking account of the position of men on bases in their relation to the kind of thing that the batter ought to do in this particular case. While all this is occurring, reflex activities essential to this whole reaction may be going on. Examples of this are the reflex acts involved in protecting the eyes from the entrance of dust or minute insects and those involved in the right focusing of the eyes with reference to the light.

The illustration just given shows the most intricate interdependence and coöperation of the three types of sensori-motor circuit in the actual process of adjustment. However much, then, we may later make of the significance of conscious processes in the adaptation between organism and environment, we cannot get a true conception of its place and function except as we take account of the contributory and related mechanical factors that are involved. In general, we may say that in the learning of new things the higher centers, involving consciousness, would function most actively, with a tendency for control to drift downward into the lower centers of the brain when any mode of activity is mastered; but no control that is attained through

learning probably ever drifts downward as far as the centers of the cord which are responsible for reflex action. And it is likewise probable that little of the mechanical type of action that is the result of preceding voluntary processes ever gets completely out from under the influence of consciousness as it functions in the third type of circuit. But, with the drifting downward of control from higher to lower brain centers, the higher centers are left free to employ their energy in meeting still further new needs, or, in terms of the accompanying conscious processes, the mind controls the learned activities with a minimum of attention and is left freer to devote itself to that which is still new and problematic.

Supplementary Readings for Chapter III

Angell, *Psychology,* Ch. II.

O'Shea, *Education as Adjustment,* pp. 78-83.

Consult chapters on the nervous system in any of the standard texts in Psychology or Physiology.

CHAPTER IV

THE SIGNIFICANCE AND FUNCTION OF CONSCIOUSNESS

1. The Functional View of Consciousness.

It has already been intimated that the conscious processes are intimately bound up with the activities of the cortical centers. We know from abundant evidence, which need not be given here, that this is true. Is it an accidental fact that these are at the same time the centers which function in terms of consciousness and in terms of variation and reconstruction of reaction processes? If we take the biological point of view, we can hardly regard the coincidence as one without any functional significance; for we have come to view all special characteristics of an organism as interrelated and as functioning together within one whole for the furthering and maintaining of the life process. Though we may not be able to explain satisfactorily either to the materialist or to the idealist the ultimate relation between conscious processes and the physiological processes of the brain, yet we may consistently hold that the two sets of activities are functionally related. In the third type of sensori-motor circuit, cortical activities and conscious processes are functionally related as inseparable phases of one whole of adjustment activity the perfection of which demands both.

2. Consciousness the Factor of Variation and Reconstruction of Reaction.

Conscious processes fall within the process of reaction only at the point of central redirection of impulses. We have seen that they come into that particular sensori-motor

circuit in which the central redirection occurs in the cortex, a mechanism which affords the largest possibility of variation and reconstruction of motor responses. This ought to suggest to us that if we are trying to interpret the special significance and function of consciousness, we should view it as par excellence the *factor of variation* of reactions whereby reconstructions are effected and new and more perfect adjustments between the organism and its environment are attained.

3. CONDITIONS OF CONSCIOUSNESS.

If consciousness is the factor of variation and reconstruction of reactions, then we should naturally not expect it to appear in the life of an organism except where variation is on the one hand possible and on the other needed or useful. There are classes of organisms of the lower type whose modes of reaction are practically fixed at birth or very soon after birth. They are capable of little or no modification. The methods of activity of these organisms have been organized in advance of their actual experience of needs into modes of procedure, called instinctive, which are adapted to the realization of certain groups of fundamental needs common to the species and which can be met, or satisfied, in an environment of a certain kind. In so far as these modes of reaction are *fixed,* they are under the control of the lower brain centers, and there is *no chance for consciousness to function in their reconstruction;* in so far as they *meet the needs of the organism mechanically* there is *no need* of consciousness. Organisms in which this sort of predetermined adjustment can be at all adequate are limited to very simple and very general classes of needs. If their fixed modes of reaction fail to meet these needs at any time, they have no remedy, but must inevitably perish.

We conclude, then, that *if already organized and existing modes of reaction,* whether reflex, instinctive, or habitual,

fail to meet the needs of the organism, this is the condition either for the appearance of consciousness,[1] *or for the more active functioning of conscious processes,* provided always that there is sufficient plasticity of the organism to permit of modification and reconstruction of its motor processes.

4. Special Application to the Human Being.

(1) Man's special need of conscious processes.

The human being furnishes most fully of all living creatures the precise conditions for the appearance and functioning of consciousness in a very large degree in his life. He is born exceedingly plastic in structure, and this plasticity continues through a very long period of infancy and even into maturity. This makes the possibility of variation from predetermined modes of activity very great. Another necessary consequence of this remarkable plasticity is that at the outset the individual cannot have many definitely organized modes of reaction. The chicken can within a day or two pick at a crumb with great accuracy and precision. But the small child cannot at several years of age eat a piece of bread and butter without smearing his face. And the child of kindergarten age has great difficulty in putting on his wraps and in buttoning his clothes. The human being starts out with an exceedingly limited number of things which he can do; almost everything has to be learned. He has few established motor coördinations in the form of instinctive modes of reaction. He has many tendencies to action, which we may call impulses rather than instincts.[2] His needs cannot be met by organized modes of activity determined in advance by heredity. From the very start his natural equipment fails to meet his demands, and in so far as they are not anticipated by parental love, there is the demand for the functioning of consciousness to organize and control his activities in such ways as to satisfy his natural impulses.

[1] *Cf.* Angell, *Psychology*, pp. 63-66.

[2] See Chapter VII for discussion of impulse and instinct.

(2) Possibility of Great Delicacy of Adjustment.

The human being starts out more helpless than any other animal, but he has the advantage in the long run. Because he starts out with fewer definitely instinctive modes of behavior, organized and determined in advance, or in the mere process of physical growth, and consequently expresses his natural tendencies in terms of more elementary muscular processes, aimless, uncoördinated, and unorganized; he has left to him the possibility of organizing his modes of reaction in his own lifetime in the light of his own specific experiences and in such forms as will meet his particular needs. An analogy may help to make this point clear. When a building comes into your possession as an inheritance, it may be roughly adapted to your needs, but in so far as it is not so adapted, it is very difficult to modify it to suit your needs in any very delicate and thoroughgoing fashion. But if you were given the elements of the structure, the bricks and the timbers and the boards, you could combine them in ways to suit yourself and make the rising structure one which should be more specifically adapted to meet your needs. While this analogy is too mechanical to be applied closely, yet it will give an idea of what we mean by saying that the human being, starting with more elementary, uncoördinated, and unorganized reaction processes, can through the function of consciousness ultimately organize his methods of action in such ways as will put him into more delicate adjustment with his environment than would be possible on the basis of a larger inheritance of already organized reaction processes.

5. Consciousness the Factor of Individual Control.

(1) The idea of control.

What we have already said about the function of consciousness has involved implicitly something of the idea of *control* over the environment. Particularly what has been said about the more delicate individual adjustment effected

through the conscious processes of the human being has implied the thought of *individual* control. As the idea of control is essential to the movement of our thought as a whole, it may be well to work it out more explicitly at this point.

a. Adjustment not involving control.

Adjustment involves change of some sort. Some adjustments are affected primarily through changes of a physiological and structural nature in the organism itself. Such is the case when the animal grows a thicker coat of hair and puts on a heavier layer of fat in the autumn and is thus adjusted to the severer cold of winter. Most of the special adjustments of lower animal life are of this character. Permanent changes have been wrought in structure through a series of generations by the process of natural selection, which have made the animals better adapted to live in their specific environment. Or the modification may be one which is due to temporary causes, as in the case of the hardening of the skin on the hands of the laboring man, which adapts him to the task of handling rough things without harm to the delicate structures lying below the outer skin.

Now change itself is not identical with control, even when adjustment is affected. In these cases of adjustment through physiological and structural change in the organism itself we do not have what we are going to call cases of control. If there could properly be said to be control involved, we should have to locate the control primarily in the environment. The environment here is the compelling factor and the organism always yields to some extent whatever be the method of adjustment.

b. Meaning of control.

But there are types of adjustment in which the change effected is primarily a change wrought in the environment. The organism is the compelling factor and the environment yields, undergoing such reconstruction as may be necessary

for the well-being of the organism. In these cases we have what we shall call *control over the environment by the organism;* the organism is a controlling factor in the process of adjustment.

(2) Kinds of control.

a. Racial control.

The control which the organism exercises may be of either of two typical kinds,—racial control or individual control. The instinctive acts of animals furnish the best illustrations of racial control. The squirrel does not take the winter environment just as it is and adjust himself to it, but he introduces into it certain modifications. In the fall he gathers nuts and stores them away in places which shall be more convenient for him, and is thus supplied with food under different conditions than those of the natural winter environment. The beaver does not take nature as it is, but he introduces extensive changes into his environment. He builds dams, cuts ditches, fells trees, etc. Thus he modifies the conditions of his environment and compels it to meet his needs more adequately.

While there may be afforded through instinctive action quite a wide sphere of control by the organism over the environment, yet the nature of this control is primarily *racial* in character. It is nothing that is inherent in the individual as such, representing his personal achievement. It has been acquired by the species in the process of natural evolution, and as it operates in the life of any particular member of the species it is dependent primarily upon the special organization of his nervous system and of his body as a whole. Such control as is exercised is effected through *inherited methods of reaction,* rather than those which have been determined by the experience of the individual. This is one reason why progress is slow, if not a wholly negligible quantity, in all species below the human.

b. Individual control.

The human being exercises control over the environment

in the process of satisfying his needs not by using methods of reaction which are determined wholly in their organization by heredity, but which are subject to great modification by consciousness. In so far as consciousness is the dominant factor in the determination of motor responses, the control is *individual* rather than racial in character. Even where modes of control are the same among human beings, yet they may be highly individual in character. Their form is not determined by heredity but by the solution of the same problem in the same way. And where likeness is due to imitation, this is a social fact rather than a racial one, and it may represent a strong individual element in so far as it involves choice and the consciousness of the relevancy of the particular mode of procedure to the attainment of individual ends.

The human race did not come through racial heredity into the use of tools, or of fire, or of steam and electricity in its attempt to control the environment for the satisfaction of its needs. While these achievements may have had in them accidental elements, yet they are due primarily to the functioning of consciousness. And the individuals of one generation may, even within the period of a decade, modify extensively their modes of life, as in the case of the application of electricity to the problems of lighting and transportation.

But even within the confines of the same social group, individuals may vary widely from one another in their modes of adjustment. Each one may be specifically adjusted to the world in which he lives in a variety of ways that are *peculiar to himself,* and which satisfy more fully the peculiar needs or exigencies of his individual life. *Racial control brings about adjustments which meet only general classes of needs common to all the members of a certain species; individual control is more varied, bringing about greater delicacy of adjustment to meet the needs which are peculiar to the individual.*

The great problem of the organism is the attainment of control over the environment. The acme of achievement in this direction is individual control. This is of incalculable biological significance. It increases the possibility of self-maintenance immeasurably above that of the lower animals which do not possess it. In the greater delicacy of adjustment which it effects between the individual and his environment, whereby his individual needs are satisfied, it makes life something that is richer in personal values and hence more worth maintaining. *It is the most significant function of consciousness to make possible the attainment of individual control.* Indeed, the whole history of civilization may be written in terms of the progressive realization, through the use of his mental powers, of man's increasing control over the forces of his environment and the more perfect adaptation, both social and individual, which has resulted therefrom.

6. Summary of the Function of Consciousness.

We have seen that where already organized modes of reaction meet the needs of the organism, consciousness does not intervene. Consciousness is the factor of variation and of change. It reconstructs old modes of action and organizes new ones to meet needs that cannot otherwise be met. Consciousness is the pioneer, the scout, always concerning itself with the new and unattained. It is continually conquering new realms of action and adding them to that which has already been brought under control.

But not only is consciousness the factor of variation and reconstruction of reactions, it is also the great factor of individual control. Through it we are freed from the tyranny of racial heredity and are able to meet the exigencies of the world in which we live in terms of our own experience. Consequently one generation may make progress beyond the achievements of its ancestors, and the individual may establish modes of reaction which adjust him very

delicately to his environment in ways that satisfy and emphasize that class of needs which are peculiar to himself as an individual. Progress and personality, these are the great fruits of conscious, or individual, control.

7. CONCLUSION.

In closing this chapter, we might point out the difference between the older interpretation of evolution and the line of thought which we have been developing here. The Spencerian formula makes evolution consist in the process of more perfect adaptation of the *inner factors to the outer,* in other words, of the *adaptation of the organism to the environment.* There is a newer view, with which our line of thought is in harmony, but which has perhaps not been so strongly stated elsewhere as it is here. We have practically reversed the Spencerian formula and made evolution culminate in the attainment of control of the organism over the environment, in other words, the *adaptation of the environment to the organism.* This is made possible through the functioning of the conscious processes, which reach their culmination in the thinking of man.

Supplementary Readings for Chapter IV

Angell, *Psychology,* Ch. III.

Horne, *The Philosophy of Education,* Ch. II, especially pp. 30-34 and 48-54.

O'Shea, *Education as Adjustment,* pp. 84-93, 99-104.

Fiske, *Outlines of Cosmic Philosophy,* Part II, Chs. XVI, XXI, XXII.

Mr. Fiske here gives the first modern scientific formulation of the meaning and significance of prolonged human infancy. The same thought in simpler form may be found in his *Excursions of an Evolutionist,* Ch. XII, pp. 306-19, and also in Butler's *Meaning of Education,* pp. 6-17, 31-2.

James, *Psychology,* Briefer Course, pp. 4, 193-4, 170-4.

James, *Talks to Teachers,* Ch. III.

Chamberlain, *The Child,* Ch. I.

Kirkpatrick, *Fundamentals of Child Study,* pp. 3-7.

CHAPTER V

DIFFERENTIATION AND ORGANIZATION OF CONSCIOUSNESS

1. Nature of the First Consciousness.

The child's first consciousness is a vague, undifferentiated whole, formless and relatively void.[1] The human being may come into the world with some quite definite tendencies to action; but he brings with him no inherited knowledge. Everything which affects his senses is new and strange. Nothing can be discriminated from anything else. The truth of this can be seen by inference from adult experience. When we adults come into the presence of that which is new and strange, we have no specialized power of apprehending it as such. If we enter a factory, with all its mass of whirring and flying machinery, our minds are dazed and confused. Our first impression, however, is a total one of some sort. We do not get separate impressions which are later put together to form the whole. We get a vague total impression first. If the adult's consciousness in presence of the new and strange is thus a vague, undifferentiated whole, how much more should we expect this to be true in general of the consciousness of the baby to whom the whole world is new!

2. General Principle of Mental Development.

(1) Statement of the principle.

Consciousness becomes differentiated and organized in the process of organizing and controlling activities. The specialization of consciousness goes hand in hand with the attitudes which our experiences impel us to take toward

[1] James, *Psychology,* Briefer Course, p. 16.

things and the modes of behavior which we employ in meeting our needs more adequately.

(2) Illustrations.

The child differentiates his mother's face and his mother's voice out from the vague background of his conscious experience in the process of trying to control his activities with reference to the meeting of his needs of food and creature comfort. His percept ball as something round, or rolling, becomes definite through his actual experiences of trying to control the ball as a plaything. He is burned with the fire, and his memory becomes differentiated as a phase of consciousness which makes use of past experiences in the control of present acts in such a way as to avoid getting burned again. He is interested in getting good things to eat. Under the stress of this interest, it is useful to remember where he has found the candy, the cake, etc. In the attempt to so control his activities as to satisfy his needs, memory is differentiated as a special function which meets needs not met by perception.

Applying the same line of thought to our illustration from adult life, we might say that so long as there is no interest, either theoretical or practical, which impels us to get a more definite impression of the factory, that impression will remain vague. But suppose that we are obliged to take some attitude toward the machinery from the fact that we are to work in the factory. Then the mind begins to observe. Analysis and discrimination take place. We notice belts and wheels and pulleys, etc. And these we see in their relation to one another. Thus we get a differentiated consciousness of the factory. But it is also the consciousness of the whole,—a reconstructed whole which is definite, clear, and well organized as compared with the first impression.

(3) Further interpretation.

Without illustrating further, we may say that it is the view of functional psychology that just as in these cases

so it is with all the specific conscious processes, their differentiation, organization, and development are necessarily involved in the process of more adequately controlling experiences. Consciousness, as we have seen, is to be viewed as the factor of variation and control of action. It must, then, assume forms adapted to the kind of work to be done. The conscious processes which control our actions must be developed with reference to the needs of the organism, and they must be organized into such modes of mental procedure as experience determines worth while in the actual process of making adjustments. This may be made clearer by an analogy.

(4) Analogy of the industrial processes.

Just as division of labor and the organization of industrial processes are determined inside of the whole industrial situation, the differentiations of structure and the organized modes of procedure being strictly relevant to the needs of that situation; so with consciousness, its differentiations of structure and its organized modes of activity fall within one whole of adjustment activity in which conscious processes are determined by the needs which have to be met. Or, just as the making of tools falls within an industrial process in which there is a need of them, and hence the form and structure of the tools made are strictly relevant to the kind of work to be done; so the differentiation and organization of the various conscious processes falls within an adjustment process in which there is a specific need of them, and hence the form and structure of these mental processes are strictly relevant to the kind of work which they are to do.

3. Doctrine of the Organic Circuit.

Just how it is that consciousness becomes differentiated and organized in such ways as to give us mental tools exactly suited to the control of our actions is a problem that cannot be solved without getting a more complete view of the reaction process than we have given up to this point.

(1) The reflex arc concept.

We have already analyzed the reaction process into its dominant phases of sensory process, central redirection, and motor process. The view of action as originating in some stimulus and culminating in a corresponding motor response, whether redirection of the impulse takes place in the cord or in the brain, is sometimes known as the reflex arc concept. It is essentially a view of action in cross-section. Or, if you prefer another figure, it is an analysis of a single pulse, or wave, or unit of action. Starting rather arbitrarily with stimulus we follow the process through to motor response and stop there. While this analysis is useful in locating the place of consciousness within an act that is already organized or that is being modified by conscious processes already developed and connected with it, yet it is a partial and incomplete analysis of the relation between consciousness and action. It is especially inadequate for the purpose of showing how consciousness ever comes to intervene between stimulus and response in such a way as to be capable of modifying action in conformity with experience. To make this plain, we need to push the analysis of action further. This we shall do under the head of the concept of the organic circuit.

(2) The concept of the organic circuit.

The life process is not an aggregate of units of action. Acts are not independent of one another within the stream of life itself; hence we cannot get a complete account of the process of adjustment in terms of the analysis of the essential elements or phases within a unit of action. In the life process itself motor and conscious processes are inextricably interwoven and interdependent. From the study of the reflex arc, it might be thought that the relation between action and consciousness was one in which conscious processes, intervening as they do in this arc between stimulus and response, always preceded and exercised a determining influence upon motor processes. But this is

only a half truth. *Motor processes may also precede and determine conscious processes.* The concept of the organic circuit tries to make clear *the mutually determining relation of motor and conscious processes upon each other.* This relation can best be elaborated, and the underlying thought of the organic circuit best be made clear, through an illustration.

a. The idea developed through an illustration.

When the baby's eyes rest upon some bright object, say his red rubber ball, the stimulus sets up a nervous impulse which reaches the visual tract in the cortex and results in a vague consciousness of something present to sense, upon which the impulsive motor response of reaching is likely to follow. But when we have described this in terms of afferent impulse resulting from stimulation of sense organ, central redirection accompanied by vague consciousness, and motor response, *we have not told the whole story.* In describing the reaction in terms of the reflex arc concept, we have taken only a cross-section of the whole activity. We have analyzed only one pulse of it. *There is something more involved* which is very important from the organic and dynamic aspect of the whole situation. When the child *reaches* in response to the stimulus of the ball, he *gets new experiences* which are registered in his consciousness. There are involved in the reaching process a host of muscular, or kinesthetic, sensations. Still further, if he succeeds in getting the ball, the reaction brings with it as an inseparable aspect the new sensations of touch, and the emotional tone of consciousness is heightened by the pleasure of achievement. These kinesthetic and touch sensations involved in the successful response become stimuli to further reaction to the ball in the form of playful manipulation for the sake of securing again the pleasurable new sensations of touch, movement, and added visual sensations, or for the sake of the satisfaction which comes from the exercise of a new field of control. Or the new experiences

registered in consciousness may be remembered and affect reaction at some later time. If, in the process of manipulating the ball, the child should accidentally squeeze it and make it whistle, the act of squeezing the ball would not be the end of the activity. It would involve further consequences which would mark it as only a phase within a larger whole of activity. A new conscious experience, very highly toned emotionally, namely, that of hearing the whistle, has come to the child. This serves as a stimulus to the repetition of the act at the present time, or, if remembered, to the renewal of the act at some other time when the ball is found.

b. The figure of the spiral.

The illustration just worked out makes clear the idea that the life process is not to be conceived in terms of an aggregate of units of action which can be adequately described in terms of stimulus and response. The muscular response does not mark a distinct end of the reaction process, but through its effect upon consciousness it may become the stimulus to a new response. Within the reflex arc, it is true that the stimulus may be followed by conscious processes which modify the response. But this response may itself be freighted with a rich supply of new sensory and emotional processes which in their return modify consciousness. And when consciousness is thus modified, it may become within another reflex arc a determining factor in further motor responses. Thus, if we take activity in continuity, rather than as a series of reaction units, we shall find the situation somewhat as follows: stimulus—vague consciousness—response—modified consciousness—modified response—consciousness still further modified—response still further modified, etc. This view of action in continuity furnishes us with the conception of an organic circuit in which motor and conscious processes mutually determine each other. The successive circuits of reaction form, as it were, *a spiral of development marked*

at each successive turn of the spiral by more definite and more perfect organization of consciousness on the one hand and of motor responses on the other.

c. Significance of the organic circuit in the process of adjustment.

The concept of the reflex arc and that of the organic circuit are not contradictory, but supplementary. The former gives us a useful analysis of reaction in cross-section, or, if you prefer to put it that way, an analysis of a single unit of reaction which reveals the elements in a reaction process. The latter gives us an analysis of reaction in continuity, which reveals the organic and dynamic interrelations of conscious and motor processes. Only through the fundamental ideas of the organic circuit is it possible to see how consciousness becomes specialized in such a manner as to guide, direct, and control action in specific ways adapted to meet the needs of the individual as they unfold in his experience with his particular environment.

In the life process, movements of some sort must precede consciousness of these movements and of their results in terms of value to the organism. The movements have been the means of bringing into consciousness certain impressions not otherwise obtainable. These impressions in turn may be utilized in the memory and image processes for the better control of the process of reaction. Further reaction may still further modify consciousness, and so on. In this way particular movements get closely correlated with particular conscious processes, and new impressions are being constantly associated intimately with particular reactions. Thus, *the differentiation and organization of conscious processes goes hand in hand with, and is relevant to, the differentiation and organization of activity.* Sensations, percepts, and images are made definite and rich through the results of repeated and varied reactions to specific things and specific situations, and they are at the same time becoming better instruments for the manipulation and con-

trol of objects, or for the right determination of acts or combinations of acts which shall best meet specific situations.

d. Consciousness a factor in self-determination.

In passing, it may be interesting to point out a rather striking corollary of the doctrine of the organic circuit. Consciousness comes in not only as the factor of variation of individual responses, but through this power of varying responses, it may in part be determining of its own development. Motor responses bring with them new experiences. In varying responses, consciousness is determining in part what further stimulations are to affect the senses. Through its control over movements, consciousness virtually selects the stimuli which shall determine its own further development. Thus interests, either natural or acquired, may be promoted and developed. If I am interested in music, I do not merely wait for harmonious sounds to occur, but I either go in search of them or I try to produce them. As I control through my conscious processes the movements which shall yield me harmonious sounds, I am also controlling my own development and determining it in that direction. In like manner I may control my own development within certain limits in matters of morals and æsthetics and intellectual power. And, in so far as I control my own development, I become a free being.

Supplementary Readings for Chapter V

Angell, *Psychology*, Ch. III, especially pp. 62-69.

King, *Psychology of Child Development,* Chs. III-XI, especially summaries on pp. 71-4, 99-100. See also pp. 11-12, 17-18.

O'Shea, *Education as Adjustment,* pp. 156-66.

Baldwin, *Mental Development,* pp. 114, 367-88.

CHAPTER VI

ORGANIC UNITY OF MENTAL AND MOTOR LIFE

In the preceding chapter we have seen that conscious processes and motor processes are functionally related within one organic circuit. Through the conception of the organic circuit we are able to see how consciousness and movement come into such relations with each other that each becomes a factor in the differentiation and organization of the other. The psychological and educational implications of such a doctrine are everywhere present. But it may be conducive to clearness, and not irrelevant to our later discussion of thinking, to formulate quite explicitly some of the most important principles which the doctrine of the organic circuit would emphasize.

1. The Unity and Continuity of Sensory and Motor Processes.

The sensory and the motor impulse are phases of one continuous movement of nervous energy from a point of origin in excitation to a point of delivery in muscular apparatus. They are aspects of a single reflex arc, or circuit. The fact that the impulse may be delayed at the cortex and modified by the results of past experience does not alter the truth of this statement. Again, motor response is, as we have seen, continuous with new sensation, thus completing an organic circuit.

From this point of view, the old pedagogical principle, "No impression without expression," needs to have added to it for its completion, "and no expression without further impression." In fact, it is the tacit implication of the added part which has made the old principle vital. Motor expression normally results in new sensory experiences which

modify and help to define original impressions. Manual training and all manner of industrial activities in the school bring the children into first-hand relation to hosts of facts and principles which are the immediate outgrowth of the activities themselves or which are involved in, or are necessary to, their success. From this point of view manual training and various expressive arts are probably much more significant for education from their possible effects upon the development of the conscious, or mental, processes than from their effects on manual dexterity as such.

2. The Unity and Continuity of Sense Perception (or Observation), Intellect (or Higher Psychical Processes), and Motor Response.

(1) Functional continuity of observation with motor processes.

We do not perceive equally all objects that affect the senses. Perception is a matter of function; percepts are in response to some need, interest, or problem of the organism. As I come home from school, I can be said to perceive very few of the trees along my route; but there are two silver birch trees which I always perceive with some degree of distinctness. They are in front of the house in which I live. I need to see them; they are the sign by which I know that I have arrived at the proper place to turn in from the sidewalk to the house. The perception of these two trees serves a useful function. It is a part of the process of determining a particular motor process and is strictly relevant to that process. So it is, as a rule, with all percepts. They satisfy some need or are in response to some interest, native or acquired. They belong in a circuit of adjustment activity which should normally result in some motor change. This change may be either direct or indirect. In the case cited of the perception of the birch trees, the perception process was directly related to the motor process. In other cases it may be only indirectly related to the motor

process through the modification or development of an attitude of mind which in turn shall be determinative of future acts. For example, my perception of a drunken man may not function directly in the control of any present act of mine; but it may function in the determination of an attitude of mind which shall make me decline to drink intoxicating liquors when they are offered to me.

If the need which calls for perception processes is one that has been met frequently in the past by the same mode of reaction, then the connection between percept and response is immediate; the response is determined by habit without calling forth any higher intellectual processes. Take the illustration of the two trees again. I have turned in to my house so often upon perceiving these two silver birch trees that now there is a very close association between the perception of the trees and the act of turning in from the street. Moreover, the mode of response has become definite, if it was not so before. The act follows immediately upon the proper percept. Casual observation is adequate without the need of any higher psychical processes.

(2) Functional continuity of observation with higher psychical processes.

But perception does not always function thus smoothly, and it may need to be supplemented by higher psychical processes. If the situation is problematic, as, for example, when I first moved into the house previously mentioned and did not know its location thoroughly, perception alone was inadequate to meet the needs of the situation confronting me when I wished to find the way home. I had to supplement the perception experience with definite memory processes in which I called up elements of my previous experience to verify my percepts before I dared to turn in with confidence at the gate. In problematic situations, then, higher psychical processes may have to intervene between observation and response to define and solve the problem, after which response occurs in a more satisfactory and efficient manner.

(3) Observation processes absorbed in the higher psychical.

The intellectual processes once called forth to meet the needs of action do not always *intervene* between observation and response. They may *dominate and control* observation. Observation then becomes for the time being subservient to intellectual processes of the higher order, or, to put it in other words, observation is taken up into the higher psychical processes to form an organic part of them. We may use the illustration of the birch trees here also. If I had difficulty in locating my house, my memory and thought processes might be called very actively into play. Under these conditions I would observe everything relating to the solution of my problem more closely. If the idea of the silver birch trees appeared as the one most relevant to the problem of locating my house, then my observation of silver birch trees all along the street would probably become very acute. Another illustration would be the case of the hunter who has an idea that he is in the vicinity of the lair of a wild animal. He begins, under the domination of that idea, to search for tracks in the snow or for trails in the leaves, and he is alert to catch and interpret every sort of noise that may indicate the presence of the beast. *Where there is, as in these cases, a real problem; where higher psychical processes are at work whose completion demands further observation, then observation is most dynamic and vital.* What is true of life in this respect is true also of the observation processes of the schoolroom.

(4) Observation and intellection in continuity with motor processes.

Thus far we have seen the continuity of perceptual processes, with movement and also with higher psychical processes, and we have seen the unity of the observation processes with the intellectual in those cases in which the intellectual processes take up the observation processes into themselves as an organic part of the whole. Now, the

interrelation and interdependence of these processes of observation, intellection, and movement can be gotten at from still another angle. Out of motor responses frequently arise new problems, calling for further observation or for further intellectual activities of the higher type, or for both. The baby, who, in manipulating a box, accidentally pulls off the cover, finds himself face to face with a new problem; and at once he begins to explore and to investigate and to try to get the cover back on to the box. In the manual training room, the child who has driven a nail into his board in such a way as to split the wood is confronted with a problem demanding investigation. He may now for the first time see that the nail is more wedge shaped one way than the other, and he may also observe that the wood which he is using has such a characteristic as the grain. Whether he has ever seen these things before or not, he now sees them as facts with a significance as relevant to what he is doing. And this makes them more vital.

In all departments of life is it not what we do that determines very largely what we shall see and what we shall think about? If we are farmers, we observe cattle and horses and crops and lands, and what we see suggests to us new problems or variations of old ones. If we are artists, the fact that we have to paint pictures or to carve statues is constantly determining that we shall observe forms of beauty and of harmony and that we shall be finding in what we do and what we see hosts of new problems for our thoughts. In real life the need of doing things is central, and *processes of observation and of thought are organic and dynamic phases of the process of activity.*

3. The Fallacy of Isolating Observation, Intellection, and Motor Response in Training.

Our illustrations and discussions have served to make clear the point that in actual experience, viewing activity in all its continuity and fluidity, the processes of observation,

intellection, and motor response are not isolable. They are organically and dynamically related to one another, they are inextricably interwoven from every point of view. With whichever you start, you find the other two either genetically or functionally implied and necessarily involved. *They are inseparable functional activities within one whole of adjustment activity.* If this is true, then *it is pedagogically fallacious, because psychologically abnormal, to isolate any of these processes for separate training.* To make this point more specific we shall touch upon some of the fallacious isolations to which school practice is liable.

(1) The isolation of observation processes.

The isolation of observation processes for separate training is abnormal; for observation normally takes place in relation to a problem, a need to be met, a something to be done in a given situation. Observation, including the whole process of getting facts at first hand, is very important, as we shall see later,[1] for the building up of right images and the attainment of correct concepts. *But observation should proceed under the guidance and direction of some definite problem to which it is relevant.*

Pestalozzi got hold of a very important principle which needed special emphasis in his day when he insisted on the training of his pupils in observation. But when he set them to observing the cracks in the wall, that kind of observation was lacking in vitality. If there had been some problem, as for example, the question of whether the wall needed to be replastered, or the question of whether the building was settling, then there would have been some point in observing the number and character of the cracks in the wall. Observation under these circumstances would be functional and not merely formal.

There is not much sense in observing the pores on the under side of a leaf unless the observation is related to the problem of how the function of respiration is carried on.

[1] See Chapters XIII and XVII.

To observe that the north star is stationary or that the magnetic needle always points north is of little significance as a mere fact, unless it leads to the problem of finding one's direction on the sea. It is well that the old-fashioned object lessons which made observation an end in itself are being rapidly relegated to the pedagogical scrap heap. *To conduct observation exercises when there is no problem out of which observation springs or to the apprehension of which it leads, violates the functional and dynamic nature of observation processes within the whole mental life.*

(2) The isolation of the intellectual activities.

The isolation of the intellectual, or higher psychical, processes for separate training is abnormal. This is the great fallacy of formal discipline. Formal discipline values certain subjects of study and certain modes of procedure for the sake of the training which they are supposed to give to some particular "faculty," such as memory, judgment, reasoning, etc.

We would not deny that there are certain subjects of study which are more suitable than others to call into play to a large degree certain functional activities of the mind. There is no doubt that Latin gives a splendid field for the accurate and careful discrimination of the meaning of terms and that mathematics is well adapted to the training of the thinking powers. But to study these subjects merely for the sake of this training without any regard for the social and practical values inherent in them is to isolate the intellectual activities from the larger whole within which they would function normally and to make of them merely formal practice.

Formal exercises designed primarily for the exercise of this or that particular mental "faculty" ignore the principle of the organic and dynamic continuity of all the mental processes with one another and with action. Intellectual activities that are to be vital must arise out of some problematic situation in which they function to meet the demands of the

occasion, and they must somehow determine either the present motor response or some attitude for the future. This will be seen more clearly in a later discussion in this same chapter, hence we shall not give it further development at this point.

(3) The isolation of motor activities.

The isolation of motor training makes it a mere matter of manual dexterity arbitrarily determined by the instructor. It has nothing but an extrinsic motive back of it, namely, meeting the demands of the teacher. For the pupil himself it has no intrinsic motive or purpose impelling him to its accomplishment, and hence it has no real dynamic character and no intellectual value. Normally the motor process should be relevant to a problem. It may be either the concrete expression of the solution of some problem, or it may be a stimulus to the conception of a new problem whose solution, in turn, calls for further observation and for further intellectual activities.

If the child in the manual training room smooths the runner of his sled because he sees that this is a necessity in order to have the sled run easily and rapidly, then the motor process is functioning normally within the larger whole to which it belongs. If the child's drawing tells a story, or conveys a thought of his own, the motor activities involved are relevant and not arbitrary. And, if he finally comes to the point where he sees that his crude drawings are not adequate to the proper expression of his thought, even practice in the technique of drawing may be felt to be relevant; for it is seen to be necessary to the accomplishment of his end in the long run. In these illustrations, motor activity is vital through its felt necessity in the concrete realization of the solution of a problem.

But motor processes, as has already been stated, may also become the stimulus to the conception of new problems. For example, the child who is engaged in the process of weaving with cotton will learn that the seeds have to be

removed. There then arises the question of how it shall be done. Finding the first solution, that of picking them off with the fingers, a very slow process, and knowing that cotton cloth is very cheap, the question arises whether there is not some better way of removing the seeds. The child may be led to conceive this problem for himself, and to undertake its solution. His attempt to solve the problem helps to define the problem more sharply and prepares him for a right understanding of the method and the significance of the invention of the cotton gin. One of the chief values of manual training and of all the forms of laboratory science is to be found in the fact that the pupil can be made, through the results of his own activities, to confront new problems of thought the nature of which he rightly conceives and the solution of which is not formal but inherently necessary for the completion of his concrete work.

4. The Unity and Continuity of Intellect, Feeling, and Will.

Intellect, feeling, and will are not so much structural as functional distinctions. They all have their significance within one whole of activity in which adjustment is being effected to a given situation.

(1) Their functional distinction.

The functional distinction between intellect, feeling, and will may be roughly sketched through the use of an illustration. Suppose that I am paddling up a stream with a canoe. At a bend in the stream I suddenly come upon a stretch of very swift rapids. My routine activity is interrupted and now becomes problematic. The situation as a whole is immediately reflected in my consciousness in the form of *feeling*. I am surprised and probably disappointed. Now this flood of feeling will probably operate to bring sharply into the focus of my consciousness the idea of my purpose or end, which hitherto may have functioned only marginally. I did so want to get a good catch of fish to-day! And the

sharpening of the consciousness of my end, an *intellectual* process, defines more sharply my feeling of disappointment. I cannot be satisfied without having that good catch of fish. If the overcoming of the obstacle appeals to the self thus as vital, as something without which the self cannot be satisfied, then feeling is the stimulus to the arousal of further cognitive, or intellectual, processes. I must find out some way of overcoming the obstacle, I must get beyond the rapids. Perception, memory, imagination, thinking, one or all, may be called forth to define the situation more perfectly and to find the proper method of dealing with it. I observe the stream more carefully. Are there too many rocks? Perhaps there is some portion of the stream that is not so swift as the rest. I examine carefully to see. The thought occurs to carry the canoe. I remember that I did this once before and found it very heavy. I discover a footpath along the stream. The boat is too heavy when I am in it to paddle against the current. But I may walk in the footpath and drag the canoe up the stream. I have thought out a solution of the problem. When a solution of the problem is reached, then the motor tendency which has been held in abeyance in the meantime is released. But it does not operate blindly. It is under the guidance of a definite image of the end to be realized, and it is determined in its course by the idea of the means which have been chosen in solving the problem. This controlling of action by ideas is *will.*

While no single illustration can serve adequately to show the precise functions of intellect, feeling, and will, this one may have served the purpose of making clear what we mean by saying that the distinctions are essentially functional ones, each having a specific significance within one whole of adjustment activity. The sketch here given has also indicated roughly the general nature of the functions which are subserved by intellect, feeling, and will.

(2) Their essential unity.

The very method which we have employed to show that intellect, feeling, and will are functional distinctions has also emphasized their unity and continuity. This thought will now be developed a little more fully. The mere persistence of motor impulse is not will. The rat running around and around in his cage in the vain endeavor to escape is not giving a real manifestation of will. The child who fights and kicks and screams when thwarted is not truly exercising his will. The motor tendencies escaping in these cases are the raw material of will. They are basic only. Without the light of ideas will is blind and indistinguishable from pure impulse. Action is accordingly inefficient. *Will is not an independent thing; it is merely the control of action by ideas.*

Without *feeling* there is no worth-whileness, and on that account nothing gets done, no matter how clear a conception of the end there may be or how definitely the mode of procedure may be worked out. Feeling is the me-side of the whole complex of conscious processes involved in adjustment, and it cannot be separated from them without their losing all motivation and dynamic character.

Without *cognition* there is no past experience available for use and no possibility of conceiving ends and of making plans to realize them, and hence there is no control of problematic situations. No matter how much energy of motor impulse there may be present, no matter how much dissatisfaction of the self may be involved in the present situation, without the cognitive processes there can be no secure and satisfactory adjustment, except in cases where there is a solution already determined by some hereditary organization of activity or by some previously organized habitual mode of action.

In problematic situations all three phases of consciousness are necessary, and all three are interrelated and mutually interdependent. They are not separate structures; they are

rather organizations of consciousness in different ways, each mode of conscious activity being adapted to a particular phase of the work needing to be done in the facilitation of adjustment. They are to be regarded as *phases,* or *attitudes,* or *aspects* of the one unitary consciousness which appear within the complete mental act to meet specific needs within the process of adjustment. One or the other of them may be predominant in any given situation and give its name to the whole movement of consciousness according as the stress falls primarily on the problem phase of the act (intellect), or on the satisfaction or dissatisfaction of the self (feeling), or on the motor aspect of overcoming obstacles or resolving conflicts through activities which takes place under the guidance and direction of ideas (will).

5. The Fallacy of isolating Intellect, Feeling, and Will in Training.

From this functional interpretation of intellect, feeling, and will, which is inherent in the concept of the organic circuit, we can see clearly that it is abnormal and formal to isolate any one of these fundamental aspects of consciousness for separate and independent training.

(1) Isolation of the intellectual aspect.

The isolation of the intellectual phase of consciousness in the process of training is preëminently the fallacy of formal discipline. When the intellect is set apart from its relation to feeling and to action, we make the discipline of memory, imagination, and thinking purely formal. The dynamic aspect is lacking; the worth-whileness that is experienced in the form of feeling, the push-from-behind that comes from the consciousness of value to the self, is not continually stimulating and reënforcing the cognitive activities. Take away the feeling of relevancy to a situation which concerns *me,* and you take away the very heart of the intellectual process. The feeling element is, then, essential to the training of the intellect. This is usually recognized at the

present time in the demand that the child's interest be aroused. Our analysis shows from the scientific point of view *why* we must secure the interest of the child.

Neither can the training of the intellect normally be isolated from the motor process. The great function of the higher psychical processes is to give more adequate control over experience. In other words, their right-to-be consists in the fact that they are an integral phase of a more perfect will. *The whole intellectual activity is pointless unless it is to eventuate somehow in the modification or control of action, or else in the determination of some attitude which shall make a difference to future actions.* Intellectual processes have their significance in the contribution which they make to individual control. If this is true, then cultivation of intellect apart from either healthy interest on the one side or appropriate and controlled motor expression on the other side is abnormal.

(2) Isolation of the feeling aspect.

If we accept the functional interpretation of feeling, we cannot expect to train the feelings, or sentiments, of the child properly by devising exercises which are wholly imaginary for the sake of calling the feelings forth. Fairy stories may serve a useful function in stimulating the backward imagination and hastening the process of its development, but they are inadequate as means of cultivating the sentiments of the child. They deal in too many unreal situations, which furnish him with no illustrations of how to employ his sentiments in the world in which he actually lives. Feeling has normally a function to perform in the whole process of activity. It is an important factor in furthering certain activities and in checking others. Respect for the aged, reverence for parents, the love of the beautiful, pride in fair play, righteous indignation over the wrongs of the poor and oppressed, etc., cannot be adequately inculcated through words. Situations which arise must be seized upon in which these sentiments are called forth in the

process of determining action. Or, if they are situations studied in history, biography, or literature, they must be situations into which the pupil is capable of injecting himself and in which he mentally lives and acts for the time being.

Feeling should normally grow out of a concrete situation of some sort and return into that situation to inhibit or to reënforce processes which are going on there. In this way sentiment is developed as over against mere sentimentality. Mr. James very aptly says: "When a resolve or a fine glow of feeling is allowed to evaporate without bearing practical fruit it is worse than a chance lost; it works so as positively to hinder future resolutions and emotions from taking the normal path of discharge. There is no more contemptible type of human character than that of the nerveless sentimentalist and dreamer, who spends his life in a weltering sea of sensibility and emotion, but who never does a manly concrete deed."[1]

(3) Isolation of the will aspect.

The functional point of view shows the fallacy of the culture of will as a matter of sheer effort. There is necessary an intellectual appreciation of ends, together with feeling in the form of interest. *It is not necessarily true that the harder anything is to master the better it is for training the will.* If the arbitrary element in the task has been prominent, the net result of the effort put forth may be the acquisition of hatred for the subject.

Training of will is concerned with the proper development of ideals more even than it is with giving formal practice in the putting forth of effort. But these ideals must be so developed that they cannot be held off as cold intellectual propositions recognized as valid by the individual while at the same time making no vital appeal to him as having value for the self. We must develop ideals under

[1] James, *Psychology*, Briefer Course, pp. 147-148.

such conditions that they will become warmed through and through with the feeling element. This will make the ideals dynamic, and effort will follow naturally and not as a matter of sheer force. *The training of the will is in large part a question of the dynamism of ideals,* that is, of a proper union of feeling and intellectual elements, under the impetus and guidance of which acts are controlled with reference to the realization of ends.

6. The Unity and Continuity of Child Mind and Adult Mind.

As one result of the child-study movement much has been made of the differences between the child and the adult, both on the physical and on the mental side. Emphasis upon the mental differences between children and adults is of very great service to educational thought, provided it is clearly seen just wherein those differences consist. But there has been some tendency, while recognizing these differences, to let the fundamental unity and continuity of mind throughout all the stages of its development become obscured.

(1) The principle of unity and continuity.

The doctrine of the organic circuit has made clear that the differentiation and organization of consciousness is a phase of an evolving experience of adjustment and control. In this respect the child's mind is in its essential nature the same sort of a mind as that of the adult. His mind, like that of the adult, is functional to the core. *The same law applies to both.* Conscious processes are called forth under certain conditions, and they function to meet needs.

While we recognize that the mental activities of the adult are normally called forth only to meet conditions which make their functioning necessary, we sometimes act as if we thought that those of the child responded in any form that we desired merely upon our demand. Or, if not this, we too often assume that if he imitates and repeats the

forms in which our mental activities express themselves, he is actually being trained in their use. Educators talk a great deal about the self-activity of the child. *The only self-activity that is worth anything is that in which the conscious processes are called forth in situations in which they are relevant to felt needs of some sort.* In this respect, *the law of self-activity is the same for child and adult.*

(2) Difference within unity.

We have seen that on the side of function child mind and adult mind are the same,—a device for the variation and reconstruction of reactions to meet more adequately the needs of adjustment. But as the child's experience in organizing and controlling activities is more limited in extent and is simpler in character than that of the adult, we should expect to find corresponding differences in his mental make-up. From the functional point of view there must be a difference in the degree of the development and perfection of the specialized processes, or technique,[1] by means of which the function is exercised in the two cases. The child on the whole deals with simpler problems, which do not demand the more highly specialized technique of consciousness for their control. Also, he has had a more limited experience and there has been less opportunity for the differentiation and organization of consciousness in the actual process of controlling action.

Functional psychology may properly contend that there is essential unity and continuity of child mind and adult mind and at the same time insist that the child's mind be studied and interpreted in terms of itself rather than in terms of the adult mind and what we know of its highly specialized modes of activity. The child's mental processes can be understood only in terms of his stage of development and in terms of the experiences which lie back of, and are involved in, that stage of development. No amount of

[1] See Chapter IX for further explanation of the use of the term technique.

study of the adult mind can show us just what are the precise mental processes of the child. For the determination of these we must study the child himself, particularly the nature and degree of control which he has attained over action, control not resulting from the process of mere physical growth and development. Yet the full interpretation of the child cannot be given without reference to the nature of the adult consciousness. This thought must now be developed.

Child psychology reveals the process of growing control; adult psychology shows that control in its more highly perfected form. In child psychology we are studying mind in the making; in adult psychology we are taking more the point of view of the finished product. The conscious processes of the adult represent the normal goal of achievement in the perfection of the machinery of consciousness for exercising control over the world in which we live. A study of them gives an idea of the nature and the value of the various specializations, or elements of technique, which are developing in the mind of the child for effecting varied and efficient adjustment. It is the business of teachers and parents not merely to call forth the conscious processes of the child but to call them forth by supplying the conditions which shall secure their normal functioning and lead to the goal of their normal development. This requires a knowledge not alone of child psychology but also of adult psychology.

Putting this thought in other terms, we may say that the teacher needs to know what are the fundamental impulses developing in the child at any particular period in order to make these the basis of appeal and under normal motivation secure the self-expression on which mental growth and motor control must depend. But he also needs to keep his eye on the remote goal of adult development, or the normal outcome of the educative process, in order to know what impulses and tendencies need checking and what others

need stimulating. Thus he will not merely indulge the present impulses of the child but will guide and direct them along the line of development which shall be of greatest value. The present moment of child life, with all its wealth of concrete tendencies, must not be ignored. It is the dynamic center on which all future growth and development depends. But, at the same time, this present moment must be viewed as continuous with a larger whole, of which the remote but more perfectly developed future is a part.

Supplementary Readings for Chapter VI

Angell, *Psychology,* pp. 301-2.
James, *Psychology,* Briefer Course, pp. 117-18, 370-2, 147-8.
Dewey, *Psychology,* Ch. II and p. 359.
Stout, *Manual of Psychology,* pp. 56-68.
Sully, *Teacher's Handbook of Psychology,* pp. 44-51.

The references to Dewey, Stout, and Sully just given are especially fine discussions of the distinction of intellect, feeling, and will from one another and their mutual interrelations with one another as phases of a single consciousness.

O'Shea, *Education as Adjustment,* pp. 69-73, 135-7, Chs. 13 and 14.
Bagley, *The Educative Process,* Ch. 14.

O'Shea and Bagley have given the best recent discussions of the "Doctrine of Formal Discipline" of which I know. They should be supplemented by the papers of Angell, Pillsbury, and Judd in the *Educational Review,* June, 1908.

O'Shea, *Dynamic Factors in Education,* pp. 74-6.

CHAPTER VII

TYPICAL MODES OF ADJUSTMENT

1. Point of View and Purpose of this Chapter.

We have seen that there is an organic circuit of activities involved in the life process. From the biological point of view, conscious processes are not isolable from the complex of activities which are going on all the time in the attempt of the organism to secure and maintain the proper adjustment between itself and the environment. The thinking process is no exception to this rule. We cannot isolate it either from the rest of the conscious processes or from the process of reaction to which it is relevant. We cannot rightly interpret thinking apart from the conditions under which it is called forth, apart from the concrete situations in which it functions. It is intelligible only as a phase within a complete circuit of adjustment activity comprising both mental and motor processes, and the nature of the thinking process is strictly relevant to the conditions which call for its functioning and to the situations which it is its task to control.

If we wish, then, to locate exactly the place of the thinking process in the concrete life of the organism, we must study the characteristic modes of adjustment of which organisms are capable, with special reference to the problem of determining whether consciousness functions in them and in what way. This it is our purpose to do in this chapter. Though we shall find that thinking is confined to quite a narrow field of activity, it will more sharply define our conception of its significance if we first get clearly in mind, more precisely than through a mere assertion of the fact, the

extent and nature of the processes through which the needs of the organism may be satisfied *without the function of thinking.*

In the evolution of species, the acquisition of the power to think is undoubtedly a comparatively recent accomplishment. And quite likely we must pass quite well up into the scale of the vertebrates before we find consciousness functioning at all in definite modes more developed than a vague sentiency, or, at best, in forms of sense perception and of crude memory that must be thought of as more organic than intellectual in character. Even in the case of the human being, there is a large amount of useful activity which goes on smoothly, meeting the needs of the organism, without the intervention of thinking processes. We shall now take up for study some of the typical modes of adjustment, both animal and human, by means of which needs are met without thinking. Thus we shall lead up to those modes of adjustment in which the thinking process functions.

2. Adjustment without the Intervention of Consciousness.

(1) Automatic action.

Automatic action, illustrated by breathing, beating of the heart, the digestive processes, etc., meets the dominantly vegetative needs of the organism and keeps its vital processes going without the exercise of consciousness. This is important in view of the fundamental character of these processes and the need of continuity in their operation. They are removed by nature from the need of attention.

(2) Reflex action.

We have seen that there are also many reflex acts of which the organism is capable, acts which "occur in immediate response to sensory stimulation without the interposition of consciousness.[1] Such acts are relatively simple, and their function is to produce adjustments which are

[1] Angell, *Psychology*, p. 337.

directly for the well-being, often the protection, of a single member, or part, and only indirectly for the well-being of the organism as a whole. For example, the sudden withdrawal of the hand or the foot from an irritant is a relatively simple reaction, involving little coördination of activities, and it is dominantly for the good of the member affected. The same principle applies to winking, to the dilation and contraction of the pupil of the eye, to coughing, sneezing, etc. The difficulty is primarily local and the remedy is found in a local mechanism.

In certain acts of the reflex type consciousness is sometimes present, as in the case of winking or of sneezing, but it is not the determining factor. Normally the reaction is determined by laws of nervous discharge entirely independent of the higher centers through which consciousness functions. The conscious processes which appear are not, however, necessarily without any functional significance. They may be important within a larger circuit of activity, an organic circuit of which the reflex is but a part. For example, the consciousness involved in sneezing may determine that I shall get up and close the window, thus adjusting myself to a situation in which there is danger of catching cold. But the reflex act itself represents a simple, useful adjustment of a purely mechanical type. There is no variation or control by consciousness.

3. Adjustment on the Organic Level of Consciousness.

(1) Instinctive action.

a. General nature of instinctive action.

If we examine the conduct of the lower animals, we find certain modes of adjustment characteristic of each species. These modes of adjustment seem not to have been learned as the result of experience, but to be predetermined by heredity, yet they are complex and highly adaptive. Common illustrations of these characteristic modes of adjust-

ment are the building of nests by the birds, the gathering and storing of honey by bees, etc. These forms of behaviour are commonly called instinctive acts.

The term instinctive is popularly used to refer to any act which is the expression of some natural tendency. Psychologists themselves use the term quite freely in this sense. We shall use it, however, in a more limited sense, a sense which has not very wide usage, but which ought, nevertheless, to be cultivated. If we are careful to analyze what it is that we have in mind when we use the term instinctive act, we shall find that the dominant thought is some organization of activity which the animal has not had to learn, yet which meets his needs. It is an *organized* mode of procedure in which the *organization is predetermined,* the animal being able to perform the act at birth, or as the result of the purely physical processes of growth and development. In so far as acts *approximate to this type,* we may properly call them instinctive. Many of the characteristic activities of animals may depart from the type, but it is not the departure from the type, it is the *large degree of conformity* to it, which impels us to call the acts instinctive.

b. Impulse and instinct.

Instinct is the inner aspect of instinctive action. Instinct is the impulse, or specific inner tendency, which is expressed in the form of the instinctive act. Not every impulse, or inner tendency, however, is an instinct. Those only are instincts for which nature has provided in advance, or in the process of physical growth and development itself, a specific and characteristic complex mode of procedure. From this point of view every instinct is an impulse, but not every impulse is an instinct. Impulse may have other modes of expression than in terms of instinctive action. In the broad sense, impulse is the inner aspect of all actions from the simplest to the most complex, from the blindest to the most highly voluntary. In a narrower sense, the term applies only to inner tendencies to action whose pressure,

or tension, *is felt in consciousness, and whose expression cannot be called either an instinctive act or a premeditated one.*

The baby's aimless and random movements of arms and legs are impulsive, and not instinctive. They lack the coördination and organization of the instinctive act. But his clutching of the hand upon the object which happens to touch it may perhaps be called an instinctive act, and certainly his original mode of taking nourishment is instinctive; for here the inner impulse has a specific, organized, and inherited mode of expression.[1] Play, imitation, and curiosity are to be classed as impulses rather than as instincts because their modes of expression are not specific. The inner tendencies are inherited and natural, but no special modes of expression are provided by nature. Almost every physical structure may be used in play, and that, too, in a variety of ways. Yet it must be admitted that in the case of the lower animals the activities of play, imitation, and curiosity are limited quite closely to hereditary lines and partake largely of the nature of instinctive acts.

c. Instinct of man and of animals compared.

It is evident that instinctive action, in the sense of the term which we employ, is more characteristic of the animals than of man. Man has many impulses, but few instincts. This is an inevitable corollary of his greater plasticity at birth and his longer period of infancy. He cannot start out with so many definitely organized modes of behavior. He may have all the fundamental impulses which lie back of the instinctive acts of animals, and many more; but their mode of expression on the one side, and their development into clear and specific inner tendencies on the other side, are both problems of his experience. The significance of this fact we have already pointed out. With a richer original

[1] This is the view of Baldwin in the Editor's Preface to Groos's *The Play of Animals,* p. vii. Groos adopts this view in his later work, *The Play of Man,* pp. 2, 283-289.

endowment of impulses and a meager endowment of instincts, man's conscious processes must be developed more fully, and he ultimately attains a superior adjustment.

d. Relation of consciousness to instinctive action.

Consciousness cannot have much determining or controlling part in instinctive action. The organization of the motor processes is too fully determined by heredity to leave much room for conscious processes to function. Powerful impulses are stirred up easily by the presence of certain kinds of situations and they drain out into prepared pathways of nervous discharge, producing reactions characteristic of the species. Both the impulses and the modes of reaction adapted to satisfy them have been built up by natural selection in the process of evolution and are now a natural heritage of the species. Hence we cannot expect them to be dependent upon individual experience in any large measure. We should expect the consciousness involved in instinctive action, then, to be of a very low and vague order.

(*a*) Feeling involved in instinctive action.

In purely instinctive modes of reaction, neither the end to be realized nor the form of the reaction process by which it is to be realized are determined by consciousness. The inner impulse is blind. Yet it is not necessarily an unconscious impulse. It may be, and probably is, in many cases an impulse which makes itself felt in consciousness in the form of a vague feeling. Migrating species of birds, when kept in captivity from their birth, have been known to manifest great restlessness when the migrating season came around. If this restlessness was not merely physical but psycho-physical, it must have been reflected in consciousness in the form of feeling. There was no basis for an intellectual consciousness of an end to be achieved nor of a method of achieving it. The feeling could get no definition in terms of past experience. The specific reaction which should relieve the tension is determined by laws of nervous

action which act in correlation with the physiological processes characteristic of a certain stage of development. Feeling may be a factor in instinctive action in the matter of reënforcing motor tendencies which are present, but it determines not at all *what* shall be done or *how* it shall be done, but only that *something* shall be done.

If the reader is not satisfied with this illustration, let him apply the same line of thought to the case of the hen sitting upon eggs, the rabbit "freezing," the child fighting in a fit of anger, or the man who has always been peaceful suddenly resenting some insulting remark by a knock-down blow. In the last instance, there is quite likely no one more surprised than the man himself at *what* he has done. Feeling was a factor in determining that motor discharge should take place, but consciousness cannot be said to have organized the method of reaction nor to have directed and controlled the response.

(*b*) Sense perception involved in instinctive action. While consciousness does not rise to the level of conceiving ends in instinctive action, and hence cannot determine either the *what* or the *how* of action, yet it may have something to do with keeping the action going until the instinctive impulse is satisfied. This it seems to do through a process of sense perception which is more organic than ideational in character.

Instinctive action is made up of a series of acts no one of which would usually have any value in itself. The separate acts are parts of a larger whole of action which is being developed under the stress of a powerful impulse which "seeks" satisfaction. The satisfaction of this impulse is possible only through the right correlation of acts with sensory situations. The sense perception process functions to further the development of the impulse and to give continuity to the series of acts. Let us take the case of nest building as an illustration. The bird is at that stage of development, or at that seasonal period, when the psycho-

physical impulse to rear young is asserting itself. The nest building impulse is a part of this larger whole, and this instinct begins to assert itself. The seeing of a straw is relevant to this impulse. If it were not, the straw would in all probability not have been noticed. Thus the inner impulse operates as a factor in the selection of stimuli to which the organism shall respond. The seeing of the straw is the occasion for an act,—the picking up of the straw. Thus the sense perception process furthers the development of the activity through which the impulse shall be satisfied. In like manner we might follow the process through the acts of flying with the straw in the mouth and of laying it down in the crotch of a limb, and with the repetition of the series until the situation presenting itself to sense perception ultimately satisfies the impulse. Now the point which we wish to make clear as a result of this discussion is that while the chaining together of a series of acts into an instinctive mode of action is in part due to the fact that a fundamental impulse operates in the selection of stimuli, yet the development of the activity is one which involves conscious processes in the form of sense perception.

We must not, however, read into the sense perception processes which function in the instinctive action of animals the characteristics of our human perceptual processes. The sense perceptions of the animal may be so purely organic in character that we could hardly ascribe any intellectual character at all to them. The selective character of the instinctive impulse, of which we have spoken, is to be viewed as organically teleological rather than ideationally purposive. It is due to a strong predisposition of the inherited constitution of the nervous system toward certain forms of activity. The satisfaction of the animal's impulses through these forms of activity puts a premium on certain kinds of sensory experience which are relevant to them. Consequently the form of activity and the receptiveness to certain kinds of sense perception have become correlated

in the process of evolution. For example, when the kitten is under the stress of the instinctive impulse to hunt, there is a pre-adjustment of the animal's sense organs. The eye is strained to see and the ear to hear. The impulse has drained out from the surcharged centers into predetermined motor channels with the result of giving the characteristic "set" to the organism which we call "watching for prey." When the right sensory impressions are received, then the kitten springs upon the moving object. But it is evident that the perception process did not involve any ideal use of past experience, that is, any image process; for the kitten had not yet had any opportunity to acquire meanings corresponding to the motor process. It is doubtful if we even have the right to call the consciousness involved perception at all.

Even with experience, the sensory processes involved in the instinctive action of animals must be less ideational in character than our human percepts. We manipulate objects more than the animals do, reacting to them in a larger variety of ways, and we also reflect upon our experiences. Hence our percepts are freighted with a richer accumulation of the results of past experiences, and they are shot through and through with the results of higher psychical processes. In perception, all of these experiences, both sensory and ideational, function automatically to determine the nature of the percept. A piece of paper is perceived by me in a very different way from that by which it is perceived by a cat. I have utilized paper in so many different ways as compared with her. I can charge this scrap of paper with meaning which flows over into it from my memory and my imagination. This I usually do not stop to do. My higher psychical processes function automatically to give the object an internally richer character than it can have for the cat.

(*c*) Organic memory involved in instinctive action. When instinctive actions are repeated in the case of the more intelligent animals, doubtless they are modified as the

result of experience. Even if consciousness assumed no higher form than that of organic sense perception this would be true; for past experiences of the sensory type modify the psycho-physical disposition, and through this modification to some extent they modify action wherever action and sensory presentation need to be closely correlated. But some of the animals show evidence of possessing rudimentary memory. Attempts to take advantage of this memory in the training of animals, however, seem to indicate that it is of the organic type sometimes called associative memory. The results of past experience are retained but not imaged. The memory is little more than a complex of associations which have been set up and perfected very slowly and which now operate almost mechanically.

e. Instinctive action and the problem of control.

Our discussion of instinctive action has served to make it evident that in this class of acts we have the animals exercising considerable control over their environment. But allowing all that we can for the function of consciousness, we see that the sphere of its operations is very limited. Some small modifications of action can be effected, but they fall quite well, as a rule, within the limits of modes of action that are after all predetermined in their essential character. And the conscious processes which function are on a level that is more organic than intellectual. Past experience can be used very little, if at all, in the conscious determination of action. The control which animals exercise is what we have in an earlier place called racial control. It meets the needs of the organism only in so far as those needs are of a general character common to all the individuals of the species.

Perhaps the writer ought to apologize for working out in such detail in a book on the psychology of thinking the psychology of instinctive action. He may, perhaps, be pardoned on the ground that so little has been done with instinctive action from this point of view. It will not be necessary in leading up to the specific conditions and func-

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tion of thinking to do more than sketch the other modes of adjustment, the psychology of which is more familiar to all.

(2) Non-instinctive adjustments on the organic level of consciousness.

If we stop to analyze human activities, we shall doubtless be surprised to find what a large amount of organization and coördination of action there is that cannot be said to be of voluntary origin so far as the organization is concerned. In walking we go through crowds, turning this way and that without bumping into anybody. We avoid stumbling over rough places, turn aside for trees, for stones, for muddy spots, and spring lightly out of the way of horses and automobiles. We come to a stream in the country and give just the right spring to leap across it. In the house we go through doors without bumping against the doorway. We carry food to our mouths quite precisely, we button our clothes, we touch with the hand any part of the body we choose. We balance on one foot, we shoot a target, we hit or catch a baseball that is thrown, we drive the tennis ball that is coming toward us right back into a corner of the court where it will be most difficult for our opponent to get it. We may, as many boys do, walk on the rail of the railway track, or even learn to walk a tight rope.

Now these forms of activity we say we have *learned* in our experience. But this is true only in part, if we mean to say that we have learned them voluntarily. The voluntary part of the procedure in almost every case has consisted in little else than fixating attention upon the goal of achievement and repeating the act. So far as the *organization* of the activity is concerned, the nervous system seems to have attended to that. This has consisted in a subtle coördination of sense perception and motor processes effected by the delicate nervous mechanism of the subcortical centers in the lower ganglia of the brain. The evidence of the truth of this is to be found in the futility of trying to learn these activities by attention to their details.

And even after they are learned, it is usually disastrous to let the mind wander from the end to the process by which the end is being achieved. Many of the motor organizations that are integral parts of larger voluntary activities, as in the case of sewing, skating, dancing, riding a bicycle, running a typewriter, etc., have themselves been effected on the lower level of organic sense perception brought into delicate coördination with motor processes through the activity of the lower brain centers.

4. Adjustment on the Intellectual Level of Consciousness.

(1) Genetic basis.

We have seen that a very large segment of adjustment activity, both animal and human, is carried on upon a very low plane of consciousness. What basis have we for the attainment of adjustment upon any higher level of consciousness? We must seek our explanation along two lines. One of these is the conditions which make more intellectual adjustment necessary; the other is the development of the ideal, as contrasted with the organic, aspect of experience.

a. Conditions of intellectual adjustment.

Man, as we have seen, has relatively few instinctive modes of action. His organized modes of procedure are not largely predetermined. Doubtless he has strong tendencies toward action in certain lines rather than others as a matter of inheritance. But the nervous connections for their performance are not made early. He is plastic for a long period. He is in a condition almost from infancy which puts a premium upon the functioning of conscious processes. His impulsive actions have to be organized by himself in order to meet his needs. This makes both ends and processes stand out more vividly in his consciousness. He has to take account of them in order to make his impulsive actions effective. It is this rich endowment of im-

pulsive modes of action, unstable, and plastic, and relatively unorganized, that is both man's handicap in the beginning of the race of life and at the same time the basis of that intellectual development which gives him his ultimate superiority.

b. Development of the ideal aspect of experience.

Any control of reaction that is not purely hereditary involves profiting by past experience. Even on the low level of organic sense perception, there is something of this. Sensory experiences repeated modify the psycho-physical disposition. That is, inner tendencies to action get "set" in certain directions rather than others as a result of preceding experiences. But this does not necessarily involve any development of the ideal aspect of the experience. And it takes place within narrow limits.

The first step in the development of the ideal element is the enrichment of sense perception. If we analyze sense perception, we find that it involves two factors,—one that of getting sensory data, the other that of interpretation. When I see a tree, my eye gives me only certain details of color and form. My mind supplies further visual details which I cannot see at this distance, facts of past experience also which came from touch and other special senses. On the basis of the data which vision gives me, then, my mind supplies enough other details from past experience for me to know that the tree is an elm tree. I perceive elm tree. In this perception there have been involved certain immediate sensory elements and certain other elements which are ideal. The sensory elements have been the data and the ideal elements have served the function of interpretation of the data. In actual experience we cannot normally have the two aspects separately. If we could isolate the element of sensory data, that is what we would mean by pure sensation, while the whole process would be perception.

A moment's reflection will show us that pure sensation, if there be such a thing, does not offer us any basis for the

control of reaction. It may serve to instigate movement, but *what* movement? There is nothing to determine that, unless it has been predetermined by heredity. If our whole mental life could be reduced to a mere flux of sensations, each absolutely new and unmodified by any previous experience, it is evident that there would be no basis for the conscious determination of one movement rather than another. But when sensations are interpreted, when they are surcharged with meaning derived from past experience, then they may be factors in the determination of action in harmony with experience. In our study of instinctive action, we have already pointed out the fact that through his more varied life of action, the percepts of the human being become much richer than those of the animal in ideal elements. Human percepts may rise above the level of organic sense perception. Many of them, perhaps, do not; but in so far as they do, they become superior elements of control over action.

(2) Voluntary action of the ideo-motor type.

a. Meaning of voluntary and ideo-motor action.

In the general sense of the term, *any act that takes place under the guidance and direction of an image is a voluntary act.* But we must construe image to include the ideal element in perception as well as in imagination. It is the functioning of the ideal element in experience to control action, even though it may function unreflectively, that makes it voluntary action. When the ideal element, or meaning, has become so thoroughly developed in connection with any mode of reaction that *"the act occurs immediately and unhesitatingly upon the idea of it,"*[1] *the action belongs to the ideo-motor type.*

b. Ideo-motor action on the perceptual level.

The mere perception of the water faucet when I am thirsty is sufficient to release the definite mode of reaction which shall meet my need. The perception of the ring of

[1] James, *Psychology*, Briefer Course, p. 423.

the door bell is followed immediately and unhesitatingly by the appropriate series of acts for that occasion. Here ideal elements of perception are well developed. There are virtually images functioning implicitly in the perception process. The water faucet is not merely a physical thing of a certain size and shape. It has a meaning which operates in consciousness. So with the perception of the ringing of the door bell. It is not merely the ringing of a bell, but it is the *door* bell, and that means that somebody wishes to enter. But the point that is most significant for our discussion is that the situation is met by an appropriate mode of reaction at once on the basis of the meaning of the perceptual activity. A large part of our activity, as we have previously shown, may be accounted for in terms of sense perception processes that are quite largely organic in character. There is still another large segment that may be ideo-motor on the perceptual level.

c. Ideo-motor action on the level of memory and imagination.

Even where these highly developed perceptual processes prove inadequate to the needs of the situation, consciousness does not yet necessarily function in the form of thinking. There are still other possibilities. The appropriate mode of reaction may be instantly released in response to some quite definite image process. For example, when I am walking through the woods and come suddenly to a fork in the road, I may see a large tree upon one fork, and the definite recollection may come to me instantly that I passed that tree on a former trip, whereupon I take that branch of the road and arrive safely at my destination. Here we have memory functioning in ideo-motor fashion to determine action without thinking. Upon hearing a shrill cry, the image may come instantly into my mind of a child who has fallen off from the porch. In this case the appropriate mode of reaction follows immediately upon the emergence of that image. Or, to take a more complex case, the idea

comes into my head to play on the piano. Immediately upon the presentation of this idea I go through the series of acts involved in getting up from my chair, walking to the piano, and playing some familiar tune. In these cases, the idea, or impulse, has been satisfied without any thinking process.

d. Significance of ideo-motor action for control.

It is of very great significance from the point of view of control that it is possible for ideas to become so closely connected with definite motor processes that the idea can thus touch off an appropriate mode of reaction immediately. A large part of the significance of habit is to be found in the fact that definite and well-organized modes of procedure have been put at the beck and call of ideas. It is like having a complicated piece of machinery which can be operated by pushing a button here and turning a lever there. Ideo-motor action presents a situation in which, as it were, an idea pushes the button and the organized motor process does the rest.

This suggests the thought that habits are very useful instruments of the organism in the control of the environment so long as the individual keeps them in their proper place as *servants of his ideas.* Thus they become valuable elements of technique in voluntary action. Pedagogically this means, if we may be allowed to digress still further from the main line of thought, that motor training in the school should not be given wholly as a series of dictated exercises or drills, but it should be the expression of ideational processes, to the end that the pupil may have not merely a set of motor habits but *a set of habits under the control of his ideas.* The starting point in the training should be with the idea, and the repetition of the motor process, or the drill, should be for the sake of perfecting the physical mechanism by means of which the idea shall operate successfully in life.

To return to the main line of thought, we may say that

in the development of ideo-motor action we have control lodged within the individual in a sense which does not apply to instinctive action. In both types of action, there is a complex organized mode of reaction at the service of the organism. In instinctive action, this mechanism is touched off rather mechanically by the nature of the stimulus. In ideo-motor action, the mechanism is at the disposal of the ideas of the individual. These ideas are the fruit of the individual's own experience, they are not merely a racial peculiarity. *In putting the mechanism under the control of ideas, the control becomes individual and personal.* Through the ideo-motor type of control, freedom, rapidity, and ease of adjustment are provided in so far as the organism is dealing with situations that are familiar and for which an organized mode of reaction has already been worked out.

e. Bearing of the discussion on the study of thinking. We have only to reflect briefly upon the study which we have been making of the various types of adjustment considered so far to see that we have implicit in them the conditions under which the function of thinking is *not* needed. Certain classes of needs of the organism can be met on the basis of little or no functioning of consciousness. This sphere of adjustment, we have seen, is relatively large, particularly in the lives of the lower animals. In other cases, where consciousness functions, and that, too, even in intellectual forms, it does so without involving any thinking process, and yet proves adequate. A study of these cases in particular shows that *thinking is not needed in situations in which there is nothing problematic,*—where on the one hand, either by reason of the simplicity of the situation or on account of its familiarity, it is immediately evaluated; and, on the other hand, an already established mode of reaction is so closely associated in experience with that type of situation that there is no question of choice, of variation, or of reconstruction.

Our study of the conditions under which the organism

has no need of the thinking process has brought us up sharply, definitely, and clearly to an understanding of the precise conditions under which thinking is necessary. The negative method of approach has served the function of sharply defining, or limiting, the problem of thinking.

(3) Voluntary action of the deliberative type.

a. Conditions of deliberative action.

Experience furnishes us abundant instances in which adjustment breaks down, or fails, on the basis of ideo-motor action. The first idea fails to suggest an adequate method of reaction, or there is some conflict of ideas which impedes and delays action until it is settled by reflection. The necessity of delay between the having of the idea and response to it is the condition which calls forth the process of thinking. In this interval conscious processes actively function to effect readjustment. This functioning of consciousness is deliberation, reflection, or more simply, thinking; and the type of action is deliberative as contrasted with ideo-motor.

b. Illustration

The thought occurs to me to build a fire in the furnace. In harmony with this thought, the reaction process is touched off in the routine channel. But the fire won't burn. The process of adjustment has broken down on the ideo-motor basis. The idea has not yet been realized. Its realization is interrupted and delayed. The interval of delay may be utilized in the attempt to effect a readjustment by blind experimentation, or it may be utilized in the attempt to solve the problem reflectively. Let us take the latter case. I begin to reflect upon the situation. I mentally go over what I have been doing to determine whether it was all right, or to locate the point of difficulty. Did I clean out every part of the furnace properly before putting in the fuel? I investigate to find out. Observation, or further perceptual processes, come in here to assist memory. Did I have the chimney cleaned during the summer?

Active memory functions here. Suppose that I take out all the kindling and the coal, put them all back in a different order, go and get some kerosene and pour it over the whole, rearrange all the drafts, and then light the fire. Yes, that will be a good plan; that is what I shall do, and I shall expect that the fire will burn. Here active imagination has been functioning. As a result of my deliberation in the interval between the original idea and the ultimate reaction process which is to secure adjustment, the whole method of procedure has been mentally reconstructed.

c. Deliberative action the specific field of thinking. This mental reconstruction which goes on in the interval of delay between idea and response is a process of thinking. It is in the deliberative type of action that thinking performs its normal function. The conditions and function of thinking will be taken up more in detail in the next chapter. We have sought primarily in this chapter to give its setting in the whole series of adaptive activities. We have been leading up to a point of view for its dynamic interpretation.

Supplementary Readings for Chapter VII

Kirkpatrick, *Fundamentals of Child Study,* Ch. 3.
Stout, *Manual of Psychology,* pp. 242-5, 251-63.
James, *Psychology,* Briefer Course, Ch. 12 and pp. 422-9.
Angell, *Psychology,* Chs. 15, 16, 17 and pp. 397-402.

CHAPTER VIII

CONDITIONS AND FUNCTION OF THINKING

1. Conditions of Thinking.

We have located the thinking process in the process of adjustment as a necessity of problematic situations in which adjustment is delayed until some reconstruction can be effected by the ideational use of past experience. The conditions of thinking may be analyzed more closely by considering the different ways in which the process of adjustment may become problematic. For practical discussion these may be reduced to three general types. The problem may center (1) in the end to be attained, (2) in the appropriate means to be employed, and (3) in the organization of the means into a definite mode of procedure.

2. Problem in the End.

(1) Vagueness of the end.

In many situations which confront us we feel impelled to do something, we feel that action of some sort is called for, but the end is too vague to serve as a basis for the determination of a course of procedure. Action is blocked, and deliberation must ensue before anything can be done satisfactorily. The vague end must be developed, cleared up, and made more definite before reaction can take place.

Many of the most difficult problems in life are of this sort. We do not know exactly what it is that we want to do, what our aim precisely is. Consequently we go blundering along in inefficiency, unless we hold our processes of reaction more or less in abeyance until we can think the whole situation through and clear it up. I may have a vague idea that I wish to be a reformer, or it may be a missionary. But what is it to be a reformer? Just what

does it mean to be a missionary? I cannot tell *what* I must do nor *how* to do it until I have a clear idea of the end to be attained. Then it will be possible for me to so order my course of action as to prepare myself properly for my chosen calling. If I know exactly what it means to be a missionary, I may choose to study medicine and prepare myself to practise the healing art as one of the means which I shall employ in realizing my end. And of course I shall have to study carefully the religious impulses of those to whom I am to go as well as grounding myself in the essentials of my own religion.

In school work, we find that the problem of clear thinking often first centers in the problem of clearly conceiving the end to be attained. Particularly in arithmetic and geometry is this seen. The statement of the problem must be analyzed and carefully interpreted before any other work is begun. In geometric demonstration, failure is very often due to the fact that the student has not clearly defined his end before undertaking his solution. And all of us who have ever been in school, whether as pupils or as teachers, have seen children rush into the solution of problems in arithmetic, beginning at once to add, subtract, multiply, or divide, before they had taken the trouble to ascertain exactly the end to be realized. Certainly one phase of a problematic situation calling for thinking is the end to be attained. The stress of the problem may center in the definition of the end, and all the rest may be easy. It would be as easy to illustrate the same point in laboratory work and manual training as in the case of the more theoretical, or book, subjects.

(2) Conflict of ends.

In some cases the problem centers in the end because conflicting ends present themselves, each competing for motor expression. Such is the classical case of Antigone. Should she obey her sovereign and leave her brother unburied? Or should she obey the religious impulse which made it a

sacred duty to give her brother burial? Not only is such a case one which calls forth the feelings in a most intense form, but also it is one in which the thinking process is involved in a very vital fashion.

This type of situation, in less intense form, is quite characteristic of our complex life. A simpler illustration would be the case of the student who has a lesson to get in the evening and is also invited to go to a very attractive concert. Two ends are presented at the same time to consciousness, each with its particular kind of appeal. The movement of thought is somewhat as follows: "It is only a few days before examination. I am none too well prepared. Can I afford to lose the time? I should be horribly chagrined if I should fail. On the other hand, this is an exceptionally good concert. The soloist is a prima donna of international reputation. If I do not hear her now, am I likely ever to have the opportunity again?" Thus both aspects of the situation are canvassed. The thinking process is very active. Its function is to find some solution of the conflict. This may be through a careful evaluation of each of the ends and a choice of that one which, taking everything into consideration in the given situation, is esteemed of the greater worth. Or solution may be found in such a rearrangement of one's time as to be able to realize both ends. In either of these cases the conflict ceases, and the appropriate mode of reaction follows.

3. Problem in the Means.

One may know quite definitely what he wants to do, but there may still be the problem of what means to employ to reach the end. The poor young man may have definitely conceived of himself as some time in the future an educated man. He is going to college. But what means to choose to get the money with which to accomplish his end is a great problem, and one which requires careful thought.

There are a variety of possible ways of earning money, that is, of means to be employed. He must carefully consider them to determine which are best. If, as soon as this problem is solved, he knows just how to organize his means into a definite mode of procedure, then the reaction is freed and he may immediately enter upon that series of activities which is going to culminate in his finding himself within college walls.

4. Problem in Method, or Organization of Means.

If the young man has selected his various means of earning the money with which to go to college, still there may be the problem of how best to organize these means into a definite series of steps, every one of which shall occupy its proper place in the whole in due relation to every other so as to lead most directly and efficiently to the end.

To take another illustration, in building a house one may have quite a definite conception of the end, he may also have his means in an abundance of building materials and tools and laborers. But there is still the problem, requiring an immense amount of thinking, of how to organize these means into a definite series of steps, a succession of proper reaction processes, which shall realize the end.

5. Restatement of the Conditions of Thinking.

(1) Distinction between means and end a practical distinction only.

The analysis here given must be regarded as only a rough-and-ready one for the sake of attracting attention to the phases within a problematic situation where the difficulty or obstacle may lie which impedes reaction and makes thinking necessary. Of course, in any philosophical view of the matter means and end cannot be so sharply differentiated from each other. Only that is a means which is relevant to an end. The choice of it as a means implies that I see its relevancy, and hence its place in a system of

processes which shall realize the end. If I have really determined the means in any philosophical sense of the word, I have also determined their organization. But for practical purposes we must make distinctions which have value in the determination of action. The distinction between cause and effect is different from the philosophical point of view and from the practical. From the philosophical point of view it vanishes in a system of relations; from the practical point of view the distinction has real value in the determination of action. So it is with the distinction here set up between means, end, and method, or organization of means with reference to the realization of the end.

(2) Illustrations.

Another illustration may serve to bring out more clearly the fact that the distinctions made are in reality only points of stress within a situation which is problematic, points of stress at which more reconstructive activity of mind is demanded than at other points within the whole process of adjustment. I am to entertain a party of friends on an autumn day. The thought comes to me that I will decorate my rooms for the occasion. Now the end thus presented seems to us at first thought quite definite. But is it so in reality?

The embodiment of the idea of the end in a specific word, "decoration", misleads us as to the real nature of the end. The end is problematic in the sense that it is vague and formless, unless the whole idea of autumn decoration is so thoroughly familiar that my mind supplies practically automatically the details of material and arrangement. If the situation is problematic because the end is vague, the process of defining the end through thinking involves the selection of the leaves and flowers and their arrangement for most pleasing effect. Only thus does the end get real content. Hence the process of defining the end and that of determining means and their organization go on together and are mutually determining.

Yet it is true that the point of view in the thinking process involved may shift so that the problematic aspect in the focus of attention is now that of defining the end, now that of determining the means as separate relevant elements, and now that of arrangement, or organization, of means. The problem of decorating my rooms has its different aspects within one whole: there is the question of what is the effect which I wish to produce, the question of the flowers and leaves available and suitable for the production of the effect, and the question of their arrangement. While none of these can be determined in isolation, yet, from the practical point of view involved in the necessities of action, any one of these may become the point of special stress where the crux of the problem is to be found; or this point of special stress, requiring the activity of thinking, may shift to and fro from one to another of these different phases within the whole process of adjustment.

Another illustration of the point which we are trying to make can be found in the teaching process. In the teaching process as a practical matter, we have to make distinctions for the sake of control which are only working distinctions. We know that they are distinctions which from a larger and more inclusive point of view do not hold. We must take account of the aim of the lesson; we have certain definite subject matter and certain well-recognized general methods which constitute our means; and then there is the problem of adjustment of this subject matter and these methods to the child in such a way as to realize our aim. In a general sense, this last is inclusive of the other two. But circumstances may be such as to make the stress of the problem fall on the definition of the aim, or again on the nature of the subject matter, or again on the specific adjustment for to-day.

(3) Summary and formulation.

There are, then, three possible problematic phases within a process of adjustment,—the phase of end, the phase of

means, and the phase of organization, or specific method. These three are mutually determining of one another, yet they represent different points of stress at which the problem may center. At whatever one of these points the situation becomes problematic we have the conditions which require the functioning of thinking to solve the problem. Thinking comes in to further the process of adjustment at points in that process where problems arise.

If we try to gather up the results of our discussion of the conditions of thinking in the form of a general principle, it would run somewhat as follows: *Thinking is called forth in situations in which there is something consciously problematic in some phase of the process of adjustment of means to ends.*

On the basis of the principle just stated, we may give the following brief definition: *Thinking is the process of consciously adjusting means to ends in problematic situations.* This definition must not be interpreted too mechanically. It is merely a brief statement to suggest to us the fuller meaning of the thinking process without having to go through a lot of qualifying phrases.

6. Relation of Thinking to Other Conscious Processes.

If we have in deliberative action the best illustrations of the function of thinking, so also does it give us striking evidence of the fact that the thinking process is not separate and distinct from other conscious processes If we were to go over in detail the illustration of deliberation given in Chapter VII in the case of the troublesome furnace fire and also all the illustrations given in the earlier part of this chapter, supplying the details in what has only been sketched, we should find that the process of deliberation is often a vast complex of conscious processes of every sort, all working upon a given situation from the point of view of a common problem. There are involved processes of obser-

vation, or further perception. Past experiences are called up in the form of memory and reproductive imagination. Images appearing in consciousness are judged and evaluated with reference to their relevancy or their irrelevancy, and on the basis of this judging some are selected and others rejected. Processes of constructive imagination are at work in the organization of new modes of procedure. And so we might go on through the whole range of specific conscious processes.

Thinking is not so much a distinct conscious process as it is an organization of all the conscious processes which are relevant in a problematic situation for the performance of the function of consciously adjusting means to end. In the performance of this function it may take up into itself perception, memory, imagination, judgment, etc. These all become phases in the whole process of consciously solving the problem. Their activity is dominated and unified throughout by their relevancy to that problem. Thinking is to be named from the *function* which is being performed, from the organization of the conscious processes to do a certain kind of work, rather than from the specific ideational elements of structure which are employed.

7. General Significance of Thinking from the Point of View of Control.

If our ideational modes of control were limited to those which have already been reduced to the form of ideo-motor reactions, our *growth in individual control* would be at an end. Fortunately not all voluntary action is of the ideo-motor type. The idea that comes does not immediately get its appropriate expression mechanically. The reaction is delayed and becomes problematic. In the interval of delay between the original idea, or the original impulse, and the motor response, thinking intervenes to reconstruct the situation with reference to the main point of stress, or tension, on which the right adjustment depends. Thinking

is the very heart and center of deliberative modes of adjustment. It is the vital phase of all reconstruction that is reflected in consciousness as problematic. It marks the highest point of the functioning of consciousness in voluntary action. Thinking is always doing reconstructive work rather than routine work. Through thinking we may reconstruct our existing modes of reaction to deal more efficiently with situations already partly under our control, and particularly through thinking we may devise methods of dealing with new situations for which our other conscious processes furnish us with no method of control. Thus, thinking is continually enlarging the field of control, particularly in those fields where adjustment is neither on the one hand a racial matter nor on the other a matter of common ideo-motor routine. What thinking achieves may, however, if repeated frequently enough, be reduced to the more automatic ideo-motor form of control, while the thinking process goes on dealing with new needs the satisfaction of which is not yet attained. Thinking is, then, preëminently the conscious process which is concerned in the development and attainment of that highest form of adjustment which we have called *individual control.*

The conception of thinking which we have developed is thoroughly functional and biological. The thinking process is viewed from its dynamic aspect as a factor of significance in the concrete life of the individual. It is easy in reading rapidly to suppose that by this concrete life of the individual is meant primarily his physical life. It may be well not to conclude this chapter without warning the reader once more that such an interpretation of the biological point of view is too narrow to be justified. Problems of the higher life are a part of the concrete life of the individual as well as those of the physical life. There have to be mental, moral, æsthetic, and spiritual adjustments and readjustments in the process of satisfying the needs of human beings. The life of action and physical existence

is, indeed, more immediate and primary, but it is not for that reason of any more value in the whole process of evolution. Personality and individuality in the matter of the control which we exercise in the affairs of the higher life is certainly preferable to the dead level of routine inherent in blind custom or blind obedience to authority. Individual control is to be achieved in the realm of social and spiritual values, or any other aspect of the higher life, only by thinking, just as truly as in the world of physical science or industrial pursuit.

8. Relation between Functional and Structural Interpretations of Thinking.

In giving a functional interpretation of thinking, we do not mean to imply that it has no characteristic structural features. The very fact that thinking is an organization of the conscious processes to perform a certain kind of work would imply that the organization must have a character that is relevant to the kind of work to be done. As this work is marked by variations in the nature of the problems to be solved, we should expect variations in the structural aspects, or the technique, of the thinking process to meet differences of need inherent in the differences of problems. These elements of special structure we shall discuss in later chapters. Suffice it for the present to say that functional psychology does not ignore structural differentiations, but when it discusses them it interprets them as themselves definitely related to the more adequate performance of function. So it will be in our discussion of thinking. We must at some time point out the special elements of technique in the thinking process, but we shall do so not for the sake of the analysis itself but for the sake of the light which it will throw upon the performance of the thinking function.

CHAPTER IX

UNITY AND DIVERSITY IN THE THINKING PROCESS

1. Unity and Continuity.

From the crudest, simplest, and least adequate forms of thinking employed by the small child up to the most complex, most highly controlled, and most adequate forms used by the trained scientist or philosopher, the thinking process is from the point of view of function the same. In all the stages of its development it has the same biological significance, it has the same task to perform, namely, that of consciously adjusting means to ends. The only test that can be applied to determine whether an individual does think, be he animal, child, or scientist, is this common test of function. We must have evidence that he does consciously adjust means to ends in situations which are undeniably too problematic to be controlled by routine or customary modes of action.

2. The Principle of Difference.

The difference in the thinking process at its lower and its higher limits is a matter of the difference in the *technique* of the process. In the higher thinking process, consciousness guides and directs activities to the more adequate performance of their function through the use of a larger number and a more powerful kind of mental tools which it has forged in the course of experience. Illustrations of what we mean by these mental tools are the abstract image, the logical concept, definite modes of reasoning, etc. In the higher forms of thinking the tools have been perfected more fully, and there has been attained a

higher degree of control over them and of skill in their use.

A more complete statement of just what are the specific elements of technique in the thinking process and what is the function of each in facilitating that process must be postponed for future chapters. Our task for the present will be limited to the attempt to clarify, illustrate, develop, and apply the doctrine of identity of function with difference in technique as a point of view for studying the thinking process.

3. Identity of Function with Difference in Technique.[1]

(1) Importance of the idea.

The idea of identity of function, with difference in technique, is one of the central and dominating thoughts of this book. If the reader wishes to grasp the argument of the succeeding chapters, he must try to get this idea as clearly in mind as possible and hold it there firmly. We shall try to clear the thought up a little more fully at this point, hoping that this will be sufficient for present purposes. In applying the doctrine as an interpretative principle in the following chapters, it will become more intelligible and its significance will be more fully appreciated.

(2) Analogy from the industrial process.

What we mean by unity of function, with difference of technique, may be seen in the history of threshing grain. We have various stages of development in the evolution and perfection of this art. There is the rubbing of the grain in the hands and the blowing away of the chaff with the breath; the pounding of it with a stick and throwing of it up into the air for the wind to carry away the chaff; the

[1] My formulation here was suggested by a passage in Dewey's *Psychology and Social Practice,* pp. 9-14. He discusses mistaken identities and differences of child and adult psychology. While the terms function and technique are my own, I have applied freely his seed thought.

improvement upon the stick by the use of two sticks fastened by a thong, one stick being used for a pounder and the other for a handle, *i.e.*, the invention of the flail, and finally this supplemented by the fanning mill; and last of all comes the threshing machine with its high degree of perfection of all the parts necessary to the process, and their organization into the most efficient machine.

Throughout we have the performance of the same function in all the stages of development from the most primitive to the most modern. In this respect they are all alike; there is identity and continuity. But on the side of technique there is wide diversity between primitive threshing and modern. The significance, however, of the elaborate technique is not in itself, but in its relation to the better performance of a function to which it is relevant. Threshing may be done without the modern threshing machine, but not so well; *the function of thinking may be performed without the elaborate and highly wrought technique which characterizes the thinking of the trained adult, but such thinking can deal only with simpler situations and is not so efficient.*

(3) Illustrations.

The primitive shepherd settled the question of whether all of his sheep were in the fold by identifying each one of them personally. His mental tool for solving the problem was a specific, concrete image of every one of the sheep. Observation of oriental shepherds of recent times confirms the literal truth of the Biblical figure, "He calleth his own sheep by name." In some places shepherds of the primitive type determine whether they have all their sheep or not by a process of keeping tally. Here the mind has substituted a concrete device for the separate concrete images of the individual sheep. A herder on our western plains would solve the same problem simply by counting. His mental tools are pure abstract symbols. In all these cases there is the same practical problem to be solved. The

mental function to be performed is the same, but the elements of technique, the mental tools, utilized in performing that function are different. There is identity of thinking function, with difference of technique.

The Egyptians satisfied themselves that the square on the hypothenuse of the right triangle is equivalent to the sum of the squares on the other two sides. This truth they gathered from repeated practical experiences. The Greeks proved the same truth by going through a process of demonstration in which the truth of the proposition follows logically from the principle in accordance with which the figure is constructed. In both cases we have illustrations of thinking processes, but that of the Greeks is more highly organized and controlled. There is identity of function, but difference of technique. In logical demonstration there is a specific method of procedure for drawing inferences and checking them up so as to secure accuracy. This established method of procedure is an important element of technique in geometrical thinking, a mental tool, as it were, which the mind uses for the attainment of superior control in dealing with problems of this sort.

4. Reasoning viewed as involving Higher Technique.

It is not our purpose in this section to go into the question of the specific technique of the reasoning process. For that we are not yet prepared. It will be taken up later. We shall, however, stop a moment to point out the general line of distinction between reasoning and other forms of thinking. This we do at this point not for the sake of discussing reasoning itself, but for the sake of emphasizing again the doctrine of identity of function and difference in technique as it applies to the thinking process. It will also furnish a point of view for the discussion of certain educational ideas.

As we do not view primitive threshing and modern threshing as functionally distinct processes, no more should

we set thinking and reasoning over against each other as separate and distinct. Reasoning is thinking, but it is thinking characterized by a specific technique. Reasoning is a stage in the development of the thinking process in which the attainment of a specific, highly wrought, and well organized technique has reached its maximum. The reasoning of the trained scientist is not different in its *essential* (*i.e.,* its functional) *nature* from the crude thinking of the child. The difference centers in the matter of its *technique* and the added *control* which it gives to the individual over the whole thinking process. Through superiority in technique the scientist can make the thinking process bend more adequately to his own will in the solution of problems. This more highly controlled type of thinking we call reasoning.

5. The Thinking of Children.

(1) Fallacy of the doctrine of receptivity.

The question, "Do children think?", would seem absurd to the average parent. He would take it for granted that they do. The only reason for raising the question at this point is that educational theory and practice are sometimes shaped from the point of view that the minds of children are wholly receptive. In emphasizing the difference between children and adults (in itself a very valuable contribution of the child-study movement), it has happened that many have differentiated between child mind and adult mind so sharply as to leave the impression that thinking is a late development. This is an error which, whether it takes conscious form or only operates unconsciously to determine method, needs to be tracked down and clearly exposed.

We may consistently hold that small children (and possibly lower animals) think, while at the same time we deny that they can reason. *It does not follow that because the small child cannot reason therefore he cannot think* any

more than it follows that because primitive man did not have our modern threshing machine therefore he could not thresh grain. The trouble in the interpretation of the child's mind which has led to a tendency to minimize his power to think and to overestimate the importance of receptivity is to be traced to a subtle and almost unconscious tendency to use the terms thinking and reasoning as synonyms.

(2) *Origin and nature of the fallacious doctrine.*

Much that is erroneous and vicious in educational thought and practice has crept in through the failure to see precisely, on the one hand, in what respects ordinary thinking and reasoning are identical, and, on the other hand, in just what respects they are different. The adult consciousness, with its highly specialized forms of thinking, has been analyzed. The results of this analysis have been taken, and rightly so, as the standard of the reasoning process. Then, unconsciously identifying reasoning and thinking, while ignoring their fundamental difference, the standard of thinking (which was in reality the standard of reasoning) has been applied to the mind of the child. Failure to find the abstract imagery, the logical concepts, and other highly wrought mental tools, has led to the conclusion that the child cannot reason, which is right; but their conclusion covertly is made to carry with it the implication that he cannot think, which is wrong. With this implication is bound up another, namely, that childhood is a period of receptivity and not of thinking, hence training consists in filling the mind with a host of facts about which he shall think later when his reasoning powers have developed.

(3) *Reality of the child's thinking.*

It is not to be denied that the period of childhood is one of marked receptivity; but it is also one of tremendous significance in the training of thinking. Receptivity and some form of thinking power are related facts, not distinct things. But the thinking of the earlier period is of the simpler sort

which we cannot call reasoning. It is not marked by the possession of a highly wrought technique. It is relatively undifferentiated and unspecialized in its form; but it is just as real and just as vital as that of any scientist or philosopher. The problems of adjustment of means to ends that come into the life of the child are just as real to him as any such problems are to the adult, even if they are simpler and his power of dealing with them is less. In so far as he deals with a real problem that cannot be solved by the more automatic processes of consciousness he thinks, even if the solution is very simple; in so far as his solution is lacking in the higher technique of control he does not reason.

6. Training in Thinking,—General Principles.

(1) Principle of unity and continuity,—identity of function.

The functional conception of thinking makes it a process of consciously adjusting means to ends in problematic situations. Such a process presupposes a feeling of need and the recognition of a problem. If there is unity and continuity of function in all stages of the development of the thinking process, there must also be at all levels of its development on the one hand the feeling of need and on the other the consciousness of something problematic. That is, there is both a feeling aspect and an intellectual aspect to the process. From the functional point of view the unity of the thinking process may be discussed both from the side of the feeling element, or motivation, and from the side of consciousness of problem, or intellectual activity. Both are important in their bearing on the question of training in thinking.

a. Unity on the side of motivation, the feeling element.

We have seen that normally the thinking process is calculated to meet a need; it is teleological to the core. This

is true whether the thinking be that of the little child or that of the trained adult. This means that thinking is vital only under conditions in which it functions to secure some end which the individual is capable of conceiving and does conceive as *worth while.* There is not a different law in this respect for the child from that which applies to the adult. Out in life's work men think because they need to think in order to secure results which they wish to attain. Out of school children do the same. Motivation is a law of life, not merely of adult life.

If training in thinking is to work in harmony with natural laws, and not be a process of lifting a dead weight in opposition to the laws of nature, then it can be most effectual only when it succeeds in calling forth the activities of mind in situations which in their very nature demand the organization of the conscious processes in the form of thinking to meet some need which the individual feels is relevant to him. That kind of training in thinking which is summed up in the putting of the child through a series of exercises whose sole design is to give him practice in the art, is dead at the very heart. Vital exercise of the thinking power comes only where there is motivation. The feeling element, the appeal to the me-side of the self, cannot be ignored and the process still be dynamic and suffused with a sense of reality and worth-whileness. The problem of motivation is central in all modern pedagogy. But it has been discussed too much under the head of interest, and the real nature of the problem has been obscured.

b. Unity on the side of intellectual activity, or problem.

Not only is all thinking normally in response to a felt need of some sort, but also it is a response to such a need in a particular kind of a situation. The situation which demands the organization of consciousness in the form of thinking is one in which there is *something consciously problematic.* In this respect there is unity and continuity in the thinking process in all stages of its development.

In terms of intellect, then, just as we have seen it in terms of feeling, there is not one law for the adult and a different one for the child. A problem of some sort is the essential intellectual condition and the solution of the problem constitutes the essential intellectual activity.

Thinking must be viewed as functional. The repetition of forms of thinking can give training in the forms of thinking only, not in its functional use. The function of thinking for the child as well as for the adult is the solution of problems. This is true no matter how great may be the variety of situations with which the thinking process has to deal or how great a difference there may be in the degree of complexity and specialization of the processes involved in the exercise of the thinking function. Training in thinking cannot be successful without leading the child up face to face with problems and letting him wrestle with them. Function must be emphasized first and form and technique afterwards. Let the child have frequent opportunities to work out for himself the method of dealing with problematic situations, however clumsy his solution may be, and after he has performed the function of thinking show him how he might make it easier or smoother by improving on the form.

c. Further applications.

We are accustomed to recognize these two principles, that of the consciousness of need, practical or intellectual, and that of consciousness of problem, as vital conditions necessary to adult thinking. Do we always give them their due recognition in the process of training the child to think? Or do we at this point assume in our educational practice a difference? Do we not too often expect the child to think without any motivation? Ends are presented by us, and we expect him to react to them on demand. Do we not also expect him to go through a process rather than to perform a function? And so long as he goes through the process, often dictated by us at every step and

learned, we are satisfied, even if there is in reality no conscious adjustment of means to ends wrought out by his own mental processes. To illustrate, we sometimes, though fortunately with growing infrequency, require children to go through with elaborate forms of sentence analysis, called parsing, or to learn highly logical modes of analyzing problems in arithmetic, without the child's ever having any sense of their value, and hence without their meeting any sort of need of his, intellectual or otherwise. Often he does not even conceive any real problem other than is involved in the mere form, in which he often becomes quite expert, so expert as to give the impression of an intelligence that is almost human! We substitute the mechanism for the thought function and exalt the finished product which it produces, dead though it be, above the cruder form of the living reality.

What has just been said must not be construed as wholesale condemnation of such exercises as parsing in grammar and of logical analysis of problems in arithmetic. It is merely a plea for the full recognition of the fact that on the side of motivation and of function the thinking of the child and that of the adult are to be viewed as identical in nature. Only through recognition of this fact can artificiality and formality of training in the thinking process be avoided. We are already moving in the right direction in the gradual reconstruction of the curriculum along lines which furnish concrete material for the purpose of appealing to the child's natural impulses of curiosity, imitation, construction, etc. Motivation is thus secured from the start. Moreover, the activities into which the child is led serve as the basis for the natural emergence of real, as opposed to formal, problems of a quite concrete character. Out of these will naturally spring, as they become more complex in character, problems still more highly intellectual whose solution is demanded not from without, but because of the recognized relation of these problems to some larger

whole within which they fall. Training in thinking, if conducted along these lines, would satisfy both the intellectual and the emotional conditions of the normal thinking process as we find it outside of the schoolroom, where it is performing its legitimate life function.

Of course such a view of training in thinking makes it a task that requires constant study and great skill on the part of the teacher. It requires that subject matter, whether knowledge to be acquired or modes of activity to be set up and perfected, be thought of constantly in terms of the possibilities of its use to stimulate new interests and to arouse the consciousness of new values. It requires also such skilful guidance and direction of the child that he is led to conceive problems for himself and to undertake their solution as a necessary and natural phase of the realization of his ends. Formal exercises, so far as they are introduced, come in then only to serve as models and to furnish practice in thinking processes, the nature and value of which are already appreciated. Formal training and drill are not to be condemned, but they are to be given their true psychological place, the place where motivation and function are at the maximum.

(2) Principle of difference between the thinking of the child and that of the adult,—difference in technique.

a. Application of the principle.

It has already been pointed out that the thinking of the child and that of the trained adult differ in the matter of the technique of the process. Proper training in thinking must recognize this fundamental difference. It is at this point that we must insist that the child be interpreted in terms of himself and not in terms of the adult. The types of the problematic situations to which we introduce the child must be adapted to his stage of development. They must be simple enough to be met by a less highly specialized thinking process. The relation between end and means must be more obvious in the earlier stages of development

of thinking. If we try to force the child through thinking processes in terms of our highly specialized technique, we only arrest development. It it more important that he actually make conscious adjustment of means to ends in problematic situations than that he do this in terms of the adult process.

The analysis of the thinking process of the trained adult reveals to us the goal of our process of training; but it cannot furnish the method. For this we must turn to the study of the growing, developing mind. We must understand that this mind starts out to perform a function in a crude and unspecialized way, and that it is only through a continuous reconstruction of its modes of activity in actual experiences that it develops the special elements of technique necessary to most perfect control. The crude and unspecialized processes of conscious adjustment mark the initial point in a process whose final point is determined by the highly specialized and highly controlled thinking process which we call reasoning. But we cannot reach that final point in training by any process of superposition of the finished product upon the plastic mind, or by any process of grafting the higher upon the lower. No drill upon any magic set of exercises fashioned after the workings of the most perfect and most logical mind can bridge the chasm between the untrained and the trained type of thinking. The ideal of the finished product is absolutely vicious, except as it functions to determine the remote goal. This goal can be reached only by starting with the child where we find him. He must actually make conscious adjustments of means to ends at first in his own crude and unspecialized way. The process thus set up may be improved through special attention to its technique. Through gradual and continuous reconstructions of the process, it may be made to approach in the course of time nearer and nearer to the final goal of training. But the principle is *performance of the function through some mode of expression first*

and perfection of technique afterwards. To throw the first stress upon the element of technique in training the thinking process or any other function is to reverse the natural order and to produce artificiality and arrest of development.

b. Further interpretation through an analogy.

If there is any difficulty in understanding the principle here enunciated for the training of the thinking process, it is the same as that actually employed by the best teachers in the subject of drawing and in the subject of language. In drawing, the child is not now expected first to master the elements of technique,—to practise upon straight lines and curves, etc., as separate elements,—before he is allowed to draw anything. But first there is developed some sort of image in his mind, and he is allowed to express that image freely in his own way. The results are the crudest sort of drawings, in many cases scarcely recognizable as signifying anything. Yet the wise teacher sees in them great significance. She studiously cultivates freedom of expression and does not worry about the finished product. Each day through wise suggestion and criticism the child improves in the form side of his work and almost unconsciously learns the simpler elements of technique upon which his art of drawing, or art of expressing his own images, depends. This continues until the time comes for making a special study of technique itself.

So also in language work, we now throw the stress upon expression first. We try to get the children to talk freely about things which interest them, things of everyday concern. This we supplement with oral stories for reproduction. We do not worry very much about the finished product. By suggestions here and corrections there, little by little, in so far as they do not interfere too much with the process of expression itself,—thus we familiarize the child gradually with the technique of language in the very process of its use, and only later do we make a systematic study

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of the technique and throw special stress upon it in formal lessons in grammar.

The principle which we apply in the teaching of drawing and of language is the true principle to employ in the training of the thinking process. Just as there are elements of technique in drawing and in language, so also are there special elements of technique in the thinking process. And just as it is more important at first that the child actually express himself in drawing and in language of some sort than that he express himself in the best form; *so also in the cultivation of the thinking power of the child it is more important at the beginning that he actually thinks, actually deals with situations which are consciously problematic, than that he should think in the most finished form.* The function is more important than the form. We must start with the function. The form will necessarily be crude at first, but we can help the child little by little to realize the inadequacy of his technique and gradually, through an abundance of concrete experiences of thinking, guide him into modes of thinking which are controlled by better elements of technique.

Supplementary Readings for Chapter IX

Dewey, *Psychology and Social Practice,* pp. 9-14.
Dewey, *The School and Society,* pp. 28-9, 37, 49, 65, 72, 118.
Dewey, *The Child and the Curriculum,* pp. 32-3.

It is impossible to give good specific references to these books for the purpose for which they should be read in connection with this chapter, namely, for a study of motivation. The whole discussion is relevant in the last two of the books.

CHAPTER X

TRAINING IN THINKING,—USE OF SUBJECT MATTER

1. Purpose of this Chapter.

It is not the purpose of this chapter so much to give specific suggestions for the teaching of certain school subjects as it is to give additional illustrative material which shall clarify the fundamental principles which we have enunciated concerning the thinking process of the child. Both the nature and the significance of these principles can be grasped more fully through a study of their application. A few suggestions in several subjects will suffice to make the point of view stand out clearly enough so that the teacher can apply the same principle further in the same subject or in other subjects.

In discussing subject matter from the point of view of its significance in training the thinking powers, we are not to be interpreted as supposing that such training is the sole object of the study of any or all of the school subjects. But we would like to suggest that the possibilities of training in the power to think do not reside so much in the particular subject taught as in the method of teaching it. As the idea is still somewhat prevalent that the period of elementary education is one of receptivity rather than of thinking, our discussion will concern itself primarily with the early training of the child. It will have two principal points of contact with preceding chapters,—one with Chapter VIII, which emphasizes the functional nature of the thinking process; the other with one of the fundamental thoughts of Chapter IX, namely, that early training should throw the stress upon the activity of thinking first rather

than upon the technique of the process. We would not deny, either, that the education of the child should recognize for all it is worth the fact that the period of elementary school life is one of very great receptivity. This, however, we feel has been overemphasized through a false conception of the real thinking powers of the child.

2. Kindergarten Games and Occupations.

(1) Opportunities for thinking.

It is not commonly thought that the kindergarten does, or can do, anything in the line of training to think. But there are opportunities even in the kindergarten for children to make adjustments of means to ends in situations in which there is some problematic element. What to do, and how to do it, even in games, may be determined in part by the child, without dictation at every point from the teacher.

In building with blocks or in making representations of various things in the sand box, the child has the opportunity, or may have it, of conceiving ends and of consciously organizing the means in such a way as to realize those ends. At least, some of the suggestions may come from him. In this way, the processes of sense perception, imagination, and attention are organized into a mode of mental action adapted to the performance of a certain kind of work. That kind of work is the adjustment of means to ends in situations which involve elements that are consciously problematic. An organization of the mental processes which does this kind of work, or performs this function, is a thinking process.

(2) Simplicity, yet reality, of the child's thinking.

In these kindergarten occupations, thinking is, of course, a very simple and untechnical process. Yet the conditions which make thinking necessary and useful are just as truly satisfied as they are in any of the situations which confront the astronomer or the philosopher. The problems of the latter may be more complex than those of the children, but

their solutions are no more truly cases of conscious adjustment of means to ends than the simpler ones which occur in the kindergarten. The difference is not so much on the side of the existence and vital appreciation of the problem as on the side of the development and use of special technique with which to deal with the problem.

(3) The right kindergarten point of view.

There is no doubt that the kindergarten offers a field for some training in thinking. But this training must be functional and vital rather than formal. The kindergarten must get away from the ideal of the finished product. This ideal can operate only as suggesting a remote goal. In training the thinking power of the child, the teacher must stand on the solid ground of the conception of the growing mind of the child as functional and dynamic. The imagination of the kindergarten child is rather fluid and unspecialized.[1] Hence, after all, the most important aspect of training him to think is the task of enriching and developing his imagination, particularly in terms of the symbols of concrete realities.

3. Manual Training.

(1) Motor training and skill not its chief value.

The term manual training is used here to include not only working in wood and metal but also all forms of industrial activity which depend for their motivation upon the constructive impulse or upon this in combination with the art impulse. This whole field is one which is remarkably significant in the possibilities which it affords of furnishing a dynamic basis for the acquisition of knowledge, mental discipline, and culture. Too often manual training is conceived in terms of its value in the promotion of manual dexterity and motor skill, or it is recommended because it is interesting and gives the child an opportunity to make use of his natural motor tendencies. All this may be a

[1] See Chapter XIV.

reason for the introduction of manual training into the work of the school, but such a view, if it goes no further, absolutely fails to understand the chief significance of manual training as a school subject.

(2) Vital acquisition of knowledge, discipline, and culture.

It is not educationally sufficient to give opportunity for the expression of the constructive impulse, nor to develop motor skill and manual dexterity. Rather, in the process of doing these things we should be guiding and directing the normal activities of the child in such a way that he will be getting out of them in a vital fashion, as opposed to the formal method, fundamental, elements of knowledge, discipline, and culture.

Out of these manual activities and occupations there should arise the situations which sharpen the sense of need for further knowledge and which make the acquisition of that knowledge necessary, not because it is merely an assigned lesson but because the manual processes that are being carried on demand it for their completion and perfection. There is something in the situation, if rightly handled, which makes the acquisition of further knowledge dynamic, It is a case in which the getting of knowledge is an integral part of what Mr. Dewey has called "satisfying an impulse" as contrasted with "indulging" it. In thus satisfying the impulse of construction the mental processes have been called forth and exercised in a normal fashion and their discipline has been a part of the whole process, necessarily involved.

At the same time the child has been getting a view of things in their larger relations; the occupation in which he is engaged is seen to be related to a larger and more complex whole. While it is perhaps but a single strand, yet it ramifies through the whole industrial and social fabric. The child no longer interprets from a partial and isolated point of view, and he gets a truer and saner appre-

ciation of the real values of life. What is this but culture? Is it not just as much a part of culture to understand the life and activity going on round about us as to understand the life of the Greeks and Romans? Each has its value. The latter without the former is certainly incomplete.

(3) Our problem that of discipline of the thinking process. While manual training may be conducted in such a way as to contribute definitely and vitally to knowledge, culture, and discipline, in our discussion we are concerned primarily with only one phase,—that of discipline,—and this we are to treat more particularly from the point of view of a single aspect, namely, that of training in the power of thinking. Does manual training afford the right conditions for the calling forth and exercise of the thinking function? Does it furnish these conditions in types of situations which involve adequate motivation, so that the thinking process becomes dynamic and functions to meet a real need?

(4) Opportunity for the natural functioning of thinking. Certainly the manual arts appeal to a fundamental and deep-seated natural impulse, that of construction. They need no justification to the child. The motivation is from within. Any mental process involved in satisfying the constructive impulse in a given situation becomes dynamic. Thinking, if it comes in at all, is felt to be relevant. It is only one aspect of a larger whole. Does not the child think when he is engaged in paper cutting? in moulding clay? in making boxes, sleds, toy houses, kites, etc.? Does he conceive ends, and does he consciously adjust means to the realization of those ends? If so, he thinks. The function is being performed, however little of the special technique of the thinking process of the adult we may be able to discover.

These manual occupations fairly bristle with situations in which there are problematic elements. Did you ever try to make a water-tight box for any special use? What a host of real questions arise! "What sort of wood shall I

choose? Shall it be hard wood or soft wood? Which will best stand the changes that are involved in alternate soakings and dryings? Shall I use nails or screws? Is the wood which I have selected likely to split or crack where I drive in the nails? How shall I give every piece just the right dimensions so that it will fit exactly into its place and leave no chance for the water to get through? What size must the box be in order to contain the requisite amount of water?" etc. The problem of adjusting means to end in such cases may become problematic at a variety of points, according to the extent of one's previous experiences. When the thinking process is involved at any one of these points there is nothing artificial or formal about its use. Yet this process is called forth frequently and gets abundant exercise.

(5) Appropriateness of manual training for early exercise of thinking.

Manual training is especially suited to the task of training the thinking process in the earlier stages of its development. All our present-day psychology is emphasizing the fact that motor processes are more primary than thought processes. Thought processes intervene to modify and perfect modes of reaction. The needs of the individual are thus better met. In manual training we are taking our start at the point which biology and psychology both emphasize as the right point of departure. The thought processes when they appear come in their natural setting. They are strictly relevant to a motor process which is to meet some need or satisfy some impulse. In these motor processes of manual training, process and product of activity are quite closely related. Means and end can be easily grasped and thought processes involved in making adjustment can be very simple. From simpler situations the transition is easily made to more and more complex situations, thus providing for progressive training in thinking up through the various stages of mental development.

The value of starting with the simple and concrete problems of manual training will be shown from another angle when we come to the discussion of the development of the imagination in relation to the power of thinking.[1] Suffice it to emphasize the thought at this point that the first problems of thought are most naturally those which spring from problems of action of some sort, and that only later does the thought process become so specialized as to grasp and wrestle with intellectual problems in more or less isolation from an immediately practical situation. Manual training, while furnishing an abundance of concrete problems for the exercise of the thinking function in concrete terms, should, however, also serve as the matrix out of which distinctly intellectual problems should later grow.

(6) Criticism of dictation; fallacy of ideal of finished product.

Do we realize fully enough in our schools the value of manual training from the point of view of its use in developing the power to think? It is sometimes conducted as if its sole value were thought to be in the manual dexterity or the finished products which it yielded. No problems are conceived by the children, and there is no process of conscious adjustment of means to ends on their part. The teacher dictates both end and process. The process is broken up into a series of steps. One step is dictated. When this step is completed, then another is taken in which the teacher determines just what is to be done and how it is to be done. The child needs to see for himself practically nothing of the relevancy of what he is doing, he needs to make no conscious adjustments. He has only to go through certain definite motor processes. There can be in this no training in thinking. All that the child can get is a certain amount of manual dexterity. Of course, he may secure a better finished product for the time being.

It is doubtless the fetich of the finished product which

[1] See Chapter XIV.

the teacher has been taught to worship blindly that has been responsible for her whole abnormal mode of procedure. I say "taught to worship" advisedly; for when her work is put on exhibition is it not the most finished products which are expected to appear rather than specimens of work representing stages of progress in the actual achievements of the pupils from day to day or week to week? In our anxiety for results which are immediate, tangible, and visible, we bow down to the golden calf of the finished product, substituting an unholy idolatry for the true worship of real training. Of course stimulation, guidance, and direction on the part of the teacher are necessary. Sometimes even more direct help must be given, but surely this need not be carried so far as to amount to practical dictation at every point.

(7) Increased motor efficiency from training in vital thinking.

Some scope for the exercise of the thinking powers according to the stage of their development may be left in every manual training exercise. This should be done not alone for the sake of the training in thinking but also for the increased efficiency which accrues to the manual training activity itself from the cultivation of the thinking process. A teacher in a prominent school for the professional training of teachers of manual training said in conversation with the author that he received pupils who had been through technical courses in manual training in the university, who could make every kind of joint that might be involved in any part of their work, but who were lamentably deficient in working out the problems involved in the execution of a rather simple concrete piece of work in which they had to determine for themselves what kind of joint should be used. They had evidently been drilled in technique first instead of starting with concrete situations relatively simple and working out technique in connection with the solution of problems. Their thinking and their technique were out

of relation to each other. The training of thinking in the actual manual training activities gives more varied and more perfect control over the manual arts themselves.

4. MATHEMATICS.

(1) Recognized value of mathematics.

The place of mathematics in the process of training to think need not be elaborated very fully. It is an older subject in the history of the curriculum than manual training, and the methods of handling it, have been more definitely worked out and put to the test. It is commonly thought of as *par excellence* the school subject adapted to the training of thinking processes. There is no question that on the side of conditions the mathematical branches satisfy the demand of furnishing abundant problematic situations.

(2) Danger of formalism and lack of motivation.

The possibilities of mathematics in the matter of furnishing problems we shall not need to discuss. But there are other phases which need careful consideration. There is the question of adequate motivation. Are we handling the mathematical branches in such a way that the thinking process is called forth under normal and dynamic conditions, that is, in situations where it comes in to play a real and vital part in a larger whole of activity? Mathematics involves a remarkably large amount and variety of technique. Are we making too much of the technique in advance of any felt need for it in the thinking process? While we are accustomed to think of mathematics as preëminently a thought subject, is there actually any other subject in which it is possible to do so much manipulation of symbols and forms, the elements of technique, without any real thinking?

(3) Vital training of thinking in mathematics.

Is there any way of making mathematics, particularly in the earlier stages, more dynamic and real and less a matter of formal drill? Yes, if it can be made to grow out of certain forms of activity in which the child is already inter-

ested. All forms of mathematical thought, if they have any function at all, have their justification in the added control which they give us over our activities. Arithmetical, algebraic, and geometrical formulations should, then, have a basis in activities of some sort to which they are immediately relevant, and this connection between the mathematical mode of thought and the active process to which it is relevant should be maintained until the development of mathematics as a science has impressed the mind as itself worth while for the sake of the values which inhere in the subject.

If the boy is already interested in making boxes, sleds, etc., he finds that he has to measure and compute as a part of the constructive process. Inch, foot, yard, and various combinations of these, need to be known. It is a serious matter in the making of his sled if the runners are not equidistant throughout. And the corners of his box have to be square, and the wheels of his cart or his bicycle have to be perfect circles. Thus we might go on and enumerate hosts of elementary facts and principles of arithmetic, algebra, and geometry which are bound up with the manual training activity. This fact of their connection with the satisfaction of the constructive impulse makes them relevant and vital. There is motive for learning them, even to getting right down to the task of drilling upon them.

There are some who assert that no number combination should be taught to the child until he has actually run up against a situation which has made him feel the need of it. This application of the principle seems to be extreme; but it certainly is feasible to withhold the drill upon number combinations until the child has had forms of experience in which he has been made to feel the need of these number combinations sufficiently that the teaching of a new combination does not become a wholly arbitrary process. So with those processes which belong more particularly to thinking and reasoning in mathematics. Problems in buy-

ing and selling, in laying of carpets and floors, in papering, painting, etc., if brought right down to the familiar setting of the child's everyday life, furnish situations in which means have to be adjusted to ends under conditions which make the thinking process involved and the elements of technique required seem very vital. Definite and accurate forms of analysis and of demonstration, which follow, instead of preceding, actual thinking processes to which they are relevant, are seen to be valuable acquisitions for more perfect control of the thinking process and are studied with greater relish and appreciation. The laboratory method of teaching mathematics, if it could be extended more widely, would do much to bring about more real and vital and intelligent thinking in mathematics.

5. History.

(1) Illustrations of its use.

In the study of history it is comparatively easy to develop concrete situations in which problematic elements stand forth clearly and definitely. For example, all the facts of Braddock's campaign in the French and Indian War can be made to center about the problem of the control of the Mississippi valley. Let the children be presented with an abundance of concrete facts relative to the life of the times, so that they can put themselves back in thought right into the midst of the problem. Let them see clearly the colonists pushing westward over the mountains. What would be one of the easiest routes? They will see that it will be by the valleys of the rivers that converge to form the Ohio. Let them see clearly the line of French explorers and traders crowding into the Mississippi valley from the north. In process of time they will completely shut off the American colonists from westward expansion. What will they do about it? Where will the conflict of races be likely first to occur? Why? If you were one of the leaders of the Americans or of the English, what would you regard as

your strategic point in the campaign? And what would your plan of campaign be? Suppose you were a leader among the French. Think the same thing through from their point of view. Without carrying this illustration out further, we may suggest that if children can get a situation clearly before them, viewing it from the inside, as it were, they need not merely follow the record of events, but they may anticipate them in large part as the outcomes of circumstances and conditions which are adequate to their explanation. Thus there is abundant opportunity for the exercise of the function of thinking. As a consequence of this mode of procedure the facts learned are also fixed more firmly in the mind.

The work of the great Constitutional Convention may be taken up with older pupils in such a way as to make them conceive the problem and to forecast in some measure fundamental aspects of its solution. This will require the study of an abundance of details as to the difficulties involved in the practical independence from one another of the thirteen colonies, now become states. Only through the study of an abundance of details can the problem be made to stand out sharply. Also the pupils must have considerable familiarity with the chief types of government in the various separate colonies. Knowing what forms of governmental procedure the members of the Convention were familiar with, it will be possible for the pupils to suggest certain principles that are likely to be embodied in the constitution of the closer Union. Familiarity with the excellencies and the defects of the Articles of Confederation will furnish additional data relevant to the solution of the problem. Students may judge for themselves what ideas would impress the members of the Convention as of most relevancy and of most worth. Also a detailed knowledge of the variety and nature of the conflicting interests represented would make it possible for the pupils to forecast some of the compromises which are responsible for certain features

of the Constitution, for example, the provision for equal representation of the states in the Senate and proportional representation in the House of Representatives; or the provision for the abolition of the slave trade in 1808.

(2) Value of emphasis on the concrete problem.

In so far as the study of history can be made to center about concrete problems which give meaning to the collection of masses of details and which call for the exercise of the pupil's constructive and interpretative powers in construing facts and events in terms of social and political movements, in so far is the child getting splendid training in thinking through his study of history. We are too prone to think of history in terms of record of fact. It is in reality not one half so much record of fact as it is interpretation of fact. It is a weighing, judging, and sifting of facts, leading to some reorganization which throws light upon social and political movements and makes them intelligible. In the concrete body of historical facts there lie imbedded social and political laws and principles which have meaning and significance only as they are seen in their setting.

We might give the pupil outright an organized system of historical facts closely knit and bound together by the significant laws and principles of the science. But this gives him neither a just appreciation of the facts nor of the principles involved. He has not thought them through for himself in a way that makes them forever his own, a body of working capital for further study and interpretation of social and political problems in his own time and generation. May not the pupil within certain limits be encouraged to go through the facts for himself, judging and sifting them from the point of view of some problem, making his own interpretations and discovering principles for himself, and only later bringing his interpretations and conclusions to the test of their comparison with the views of the expert historian? This would throw a decided emphasis upon thinking and would cultivate an independence

of thought which can never be secured by the process of always following and trying to understand the thoughts of others. We already have too many graduates of our schools, and even of our colleges, of the "It says" type. We ought to be developing more of those who speak with convictions of their own, convictions born of close investigation for themselves and of that clear thinking through of problems which enables one to give a reason for the statement which he makes.

6. Geography.

Geography furnishes hosts of problems that can be treated in such a way as to provide the conditions for vital thinking. We need suggest only a few by way of illustration, without working out the method of treating them. Why is the climate of England warmer than that of Labrador? Why are the lands just east of the Rocky Mountains arid? Why is the United States cutting a canal through the Isthmus of Panama? What are the conditions that have operated to make New York, Chicago, and St. Louis such large cities? It is easy to supply the data necessary to the solution of such problems. Why should not the children be left to work out the solutions for themselves so far as possible instead of being told the whole thing?

Almost all of the vital truths of geography can be brought out through the study of typical problems. The pupil can be trained to think of existing things not merely in terms of themselves,—even mountains, lakes, and valleys he may come to think of in terms of conditions and causes, in terms of processes which are going on all the time, now as well as in the past, in terms of complex relationships between means and ends. Thus he not only gets abundant practice in thinking, but he is also building up the habit of thinking, of looking for principles in accordance with which to explain the simplest phenomena which to another might be taken for granted as mere brute facts.

It would be interesting to work out suggestions for the teaching of language, reading, and some of the physical and biological sciences with special reference to the fulfilment of the conditions of thinking. But enough has been done to illustrate the principle which we wish to make clear, and to emphasize the value and the possibility of doing more in the way of training pupils in elementary and high schools to think. It is evident from the preceding discussions that the process of training children to think is not so much dependent upon the selection of a particular body of subject matter as it is upon the attitude taken toward that subject matter. No teacher can be so thoroughly circumscribed and limited by the nature of the subject matter or by the directions of supervisors as to exclude the possibility within certain limits of leading children to conceive problems and to use their own powers of mind in the struggle for their solution.

CHAPTER XI

THE ACTIVITY OF THE IMAGINATION IN THINKING

1. Thinking in Terms of its Content.

(1) Distinction between imagination and thinking.

If we look into our minds when a thinking process is going on we find a stream of imagery. Images are the content, or mental stuff, of the thinking process. But thinking differs from other processes in which past experience functions to determine action not so much in terms of content as it does in terms of the organization of the imagery and its conscious direction toward ends. Imagination and thinking are not two separate and distinct processes. Images are involved in both cases. Our attention may be taken up primarily with the forms in which ideas are embodied, with their explanation in terms of past experience and in the light of present conditions, with the laws of connection and sequence of images, etc. When we are dealing with problems of this sort, we are apt to use the term imagination. But when we think of the stream of images as organized in such a way as to perform the function of consciously adjusting means to ends, then we call the activity of imagination a thinking process.

(2) Constructive imagination and thinking.

When it comes to a case of constructive imagination the line between it and a thinking process is very shadowy indeed. From one point of view they are absolutely identical. In so far as we can distinguish them at all, it is only with reference to the aspect on which attention is fixed, whether that of content or that of function. If we are considering the mental content and the facts and laws of its

organization as related to the process of getting new mental forms, we call the process constructive imagination; if we are considering the function of this reorganization and reconstruction of the elements of past experience and their embodiment in new forms, we call the process thinking.

2. General Significance of Imagination in the Thinking Process.

In thinking, imagination gets its fullest significance and meaning. The power of imaging things or events does not exist for its own sake but to make past experience the more effective in processes of adjustment. In thinking, the image process rises to the level of meeting the needs of the organism in new and problematic situations.

(1) Necessity of imagination in conception of ends.

Thinking is teleological. It has at its bottom a practical basis. It is a process that goes on with reference to ends. It always involves some kind of forward reference. It presupposes that there is something not in your present experience which you seek to bring into it. There is an end *un*realized, still in the future. As it does not exist now in terms of reality, it exists only as a fact of consciousness. As a psychic reality it is embodied in the form of an image. In no other way can it be presented to consciousness. It would be possible, of course, without imagination to set up motor activities, to make things happen, but *we could not determine in advance what should happen.* The process would be blind and random experimentation, involving no individual control whatever. The conception of an end toward which activity is directed necessarily involves imagination.

(2) Necessity of imagination in conscious use of past experience.

Reference to the future is meaningless except in terms of past experience. All conceptions of ends are projections of some sort out of past experience. They may involve

reconstruction of past experience to assume new forms that have never been as such any part of past experience. But these forms can have no meaning except in terms of elements of past experience. This bringing of past experience into consciousness is an act of imagination. Without imagination we would be literally tied down to the present moment. The whole span of life would be a continuous present, in which everything would be summed up in the fleeting moment. Neither past nor future could enter into this moment of consciousness. To be sure, past experience might possibly modify present activity, but not with any awareness of the fact or any intention on the part of the individual. It would have to come about through organic modifications which would be completely summed up in automatic sense perception on the one side and reaction processes on the other absolutely determined by neural habit. Past experience could not function consciously in present experience and be brought to bear upon activity to modify, direct, or control that activity with reference to ends.

(3) Necessity of imagination in determining modes of procedure.

But thinking may center not alone in the determination of ends. It is concerned with the process of working out more or less in advance of action the method, or mode of procedure, by which ends are to be realized. This mode of procedure, if it is to be highly controlled, must take the form of a definite series of steps. There must be first this reaction, then that, then another, etc., until, as the result of the series of reactions, the end foreseen is realized. Now, if we could clearly conceive ends which we wish to realize, but if we were at the same time limited to the use of motor processes the results of which we could not foresee or anticipate, the whole process of realizing those ends would be blindly experimental. Many of the activities would be absolutely irrelevant, and if any were relevant it would be a matter of pure chance or accident.

Both the acts and their results must be clearly imaged in order to determine a series of reactions which shall be highly controlled in the process of realizing ends. In thinking, we anticipate on the basis of our past experience what would be the results of certain activities, and while they are still held in the imagination we judge of their probable relevancy or irrelevancy to our needs in this process of adjustment. On the basis of these judgments we reject some acts and select others, and then arrange those selected in a definite series of steps. In this way we may in imagination work out a definite mode of procedure by which we shall realize our end wholly in advance of the actual undertaking of the motor processes.

We cannot say, however, that there is no thinking in those cases in which the whole mode of procedure is not worked out in terms of the imagination in advance of its execution. In many cases the thinking and the experimental activity go hand in hand and are continually modifying each other. But this does not give the high degree of control that is realized in the other type of thinking process.

3. Restatement in Terms of Advantage of Imagination.

We might restate the discussion just concluded and get the point more definitely before us by pointing out some of the advantages which accrue from the fact that the imagination functions as it does in the thinking process. If we could not anticipate what the results of any motor process were going to be before they actually took place, but had to wait and see, then in some cases, at least, the activities by the time they had taken place would have produced results which changed the situation which we were trying to control and made it forever impossible to realize our ends. We could not go back over our series of acts and alter and reconstruct them; the activities have already taken place and produced results which are past recall. If, how-

ever, we work things out in terms of the imagination first, delaying all action in the meantime until we see in anticipation just what the result of each act in the series is going to be, we can avoid undesirable results by discarding those steps which would lead to them, and we can start all over again without any harm having been done.

The possibility of controlling the mode of reaction at every point and making it move in a straight course toward the realization of our end still remains so long as we keep the whole process in terms of the imagination until it is perfected. We can work out the steps in the whole process of adjustment over and over again, making as many corrections, eliminations, simplifications, or reconstructions as we please. And this can all be done in advance of the motor processes. In so far as our experience is rich and wide enough to enable us to do this successfully, we can get the method of reaction worked out to the finest detail, so that, when it is put over into motor terms, our end is attained without friction, loss, or inadequacy, and all with the highest degree of directness, precision, and skill. The experimentation has all been done in terms of the intellectual process of imagination in advance of action, and the process of adjustment is one that is directed and controlled by consciousness functioning in the form of thinking.

4. General Relation between Association and Imagination in Thinking.

(1) Imagination and the laws of association.

The stream of images which is constantly flowing in the thinking process moves in accordance with the laws of association. But it has been one of the functions of imagination to free the elements of past experience which are brought before the mind from much of their original setting, or context, and to make of them movable elements which shall be free to enter into new associative combinations. Thus, one's image tree need not necessarily carry with it the

thought of the particular place where the tree grew, the fact that it was in blossom, or that there was a swing under the tree, although all of these may have been parts of one original perceptual whole. Not only can the image tree be taken out of this setting and given a new context, but even the order and arrangement of its own parts can be changed at will. Constructive activity of the imagination necessary to a real thinking process presupposes fluidity of imagery, or the freedom of elements to be moved to and fro at will and to enter into new combinations. Yet these elements must themselves appear in consciousness for use in harmony with the laws of association.

(2) Accidental and logical ties of connection.

If there is any mental activity at all going on, elements of past experience are brought into consciousness through the connections which have previously been established,—connections of time and place which were accidental in their origin or connections of inherent relationship within a system, which were logical or necessary in character. It may be that my Uncle John was in San Francisco at the time of the earthquake. As a consequence of this, whenever I think of my Uncle John, I think also of earthquake and San Francisco; and whenever I think of San Francisco, I think also of earthquake and my Uncle John. One element of the whole group suggests all the others. But the additional items which are suggested come as the result of associations which may be regarded as accidental rather than as necessary. The tie of connection between San Francisco, earthquake, and my Uncle John is not one that is inherent in the nature of these things. It is an accident of time and place that binds together these various elements into one whole such that now any one of them is likely to suggest the others which belong to that whole.

But when I think of football, then of roundness, and then of moon, the associative process operating in suggesting this series is determined not by accidental but by inherent ties

of connection. Roundness is an inherent characteristic of both the football and the moon and serves to connect them in thought independently of the accidents of circumstance. In a mathematical thinking process, I may have need of the rule for finding the area of a triangle. I know that a triangle is equivalent to one half of a parallelogram with the same base and altitude. I know that the area of a parallelogram is equal to the product of its base and altitude. Then the area of a triangle is found by taking one half the product of its base and altitude. The associative process by means of which I recalled the rule for the area of a triangle depended upon inherent ties of connection, ties of connection which are logical, necessary, and universal.

(3) Superiority of logical ties of connection.

In thinking, ties of connection of either sort, the accidental or the inherent, may be taken advantage of for the purpose of bringing before the mind the elements of past experience necessary for the solution of the problem. But it is evident that the organization of knowledge, so far as possible, on the basis of inherent, or logical, ties of connection makes it more permanently and more universally available for use in a thinking process. The pedagogical implications of this are quite obvious, and we shall leave this point, for the present at least, and develop at greater length an aspect of the relation between association and imagination in the thinking process which is more likely to be overlooked.

(4) Question of control over the associative mechanism in thinking.

We talk a great deal about the laws of association, and we often forget how little control, after all, we have over the associative process as it operates in thinking. The suggestions which we need in thinking through a problem cannot be forced. They must ultimately come spontaneously through ties of connection, accidental or inherent, which already exist between what we have and what we

want. A great deal depends upon the existence and the character of those ties of connection. There is no guarantee that the mechanism of association as it operates in recall will bring just exactly the elements that we need and no others, or that it will bring the elements in the order in which we shall want to use them. In fact, we know of no way whereby we can absolutely control the process so as to be certain of securing at all those elements that we need. If we take the simple case of trying to recall a name which we have forgotten, we can see that all we can do is simply to take advantage of all the possible lines of association and follow them up in the hope that what we need may finally be suggested. Out of a superabundance of material we must select that which is relevant and reject that which is irrelevant.

5. Illustrations.

An illustration or two at this point may clarify the line of thought which is being developed and also aid in carrying it further. The first illustration will be one given by a pupil in one of the author's classes. It is the result of introspection of an actual case of thinking in the attempt to deal with a concrete practical problem.

"I am asked to play a piece of music at a recital. Various ends suggest themselves,—training in memorizing the selection, increased knowledge of music, an addition to my repertoire, cultural value, pleasure of my friends, and my own pleasure.

"I direct my attention to the field of musical thought. Various questions arise in my mind. Must the selection be short or long? Considering the nature of the program and the great expectations (?) of the audience a rather long composition must be chosen or else two shorter numbers, an 'A' and a 'B'. Why not learn something really worth having, even if long? A short number may be learned at odd moments and without so much effort. It is

to be one long number then. Fortunately, knowing the musical character of the audience as a whole will help me to decide the sort of music most acceptable.

"The composition must be classical in nature, but not too technical, as the audience is not composed entirely of musical students. The music must be either one of two varieties —either the brilliant, showy style or a more subdued and dreamy sort, but if the latter it must have a clear ringing melody throughout. With this present end in view, I make two selections: Rhapsodie Hongroise, No. 12, by Liszt and a Beethoven Sonata. Which shall it be?

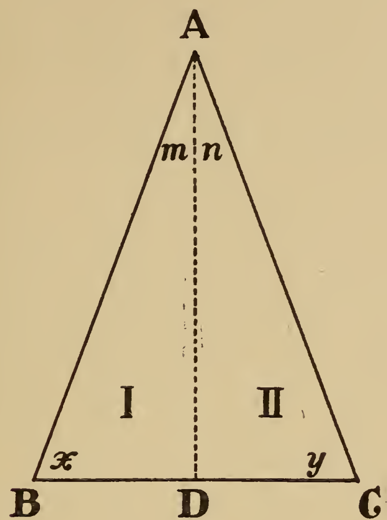
"The Liszt number will require a longer time to learn, as it is more difficult; the Sonata is a longer composition. I play them over and time the rendition. Not much difference, the Sonata taking about five minutes longer. Both selections have a variety of movements, from an andante to a vivace. However, the changes of time and movement are more sudden in the Liszt number, keeping one on the alert; while in the Sonata the slow, measured largo when once started continues for some time. You rather settle yourself and wait some time for any variation, thus taking away some of the surprises of a Liszt number.

"The Liszt number has a brilliant ending of chromatic octaves, the Sonata ends with big chords. The ending must be striking. A brilliant ending to anything will often cause an audience to be more lenient with a faulty beginning and middle.

"Then, too, the Liszt Rhapsodie will be a good thing to memorize because it is different from most of the pieces which I have already memorized, while the Sonata is very much like many others which I already know.

"After many such rejections and selections, a decision is made in favor of the Rhapsodie, with the immediate end of rendering it to suit an immediate occasion and the more remote ends of training, added knowledge, and pleasure."

The second illustration will attempt to reinstate a form of thinking which is quite common in geometry.



Let us take the familiar proposition: "The angles opposite the equal sides of an isosceles triangle are equal."

Given the isosceles triangle *ABC*, in which *AB* equals *AC*; to prove angle x equals angle y.

Now, if the proposition is attacked as an original exercise, and is not a mere reproduction of something learned from a book, a course of thinking something like the following is often that which takes place:

"I will draw a line *AD* perpendicular to *BC*. Then I have two triangles, I and II. I wonder if I can prove them equal. If I can, then all their homologous parts will be equal, and I can show that angle x equals angle y.

"I know that *AB* of I equals *AC* of II, by definition of isosceles triangle; and that *AD* of I equals *AD* of II, by identity. Now, if I could only show that angle m equals angle n, I would have two sides and the included angle of one triangle equal respectively to two sides and the included angle of the other, and triangle I would be equal to triangle

II. Is angle *m* equal to angle *n*? I don't see any way of showing it.

"Can I prove the two triangles equal in any other way? Two triangles are equal if they have a side and two adjacent angles of the one equal respectively to a side and two adjacent angles of the other. I look at my figure. Same trouble with angles as before. Two triangles are equal if the three sides of the one are equal respectively to the three sides of the other. Now, maybe I can get along without those troublesome angles. Let me see. I had two sides of the one equal respectively to two sides of the other. I must show that *DB* is equal to *DC*. Stuck again. They do look equal, but there is nothing in my hypothesis or my construction that makes them so.

"What shall I do? Could I make them equal? Oh, yes, I might draw *AD* to the middle point of *BC*. Why then, it is all done. I will have the three sides of one triangle equal respectively to the three sides of the other. The two triangles will be equal; and angle *x* must be equal to angle *y*."

When the results of the above thinking process are thrown into the form of a logical demonstration, the whole procedure will be condensed into the following brief compass:

Draw *AD* to the middle point of *BC*.

Now in triangles I and II,

> *AB* of I equals *AC* of II, by definition of isosceles triangle.
>
> *AD* of I equals *AD* of II, by identity.
>
> *DB* of I equals *DC* of II, by construction.

Therefore triangle I equals triangle II.

> (Two triangles are equal if the three sides of the one are equal respectively to the three sides of the other.)

Therefore angle *x* equals angle *y*.

> (Homologous angles of equal triangles are equal.)

Q. E. D.

Our study of the thinking processes as they actually take place in attempts to solve vital problems will serve to emphasize several things which are to be stated and developed explicitly in the series of topics which will constitute the remainder of this chapter. The reader is asked to keep these illustrations in mind as he continues.

6. Further Discussion of the Control of Association in Thinking.

(1) Limitations of control.

Our illustrations have made it evident that there can be, at best, only a limited amount of control over the associative process as it operates in thinking. This is equally true whether the problem which provokes thought be practical or theoretical. Even in mathematics, where the whole field is definitely limited and circumscribed, we see that the absolutely essential ideas do not come on demand, and when they do come it is not in their perfect order of relationship. There are abundant suggestions thrown up on the basis of past associations. All that the associative mechanism can do is to give forth what has been committed to it in harmony with the nature of the ties of connection which have been set up. These suggestions have to be judged, evaluated for present purposes, and selected or rejected. Finally, the results of the whole process may be thrown into the form of a demonstration, in which the essential elements are organized into a definite series of steps in which the relationship of means to end is clearly exhibited and made apparent.

In practical problems of conduct and in theoretic problems of economics and science, the essential elements of problems are not usually so sharply defined and contained within narrow and closed limits as in mathematics. Consequently the control over the associative activity in the attempt to get relevant suggestions is still more limited, and the process of groping for suggestions, feeling for their

relevancy, starting over again on new lines of attack, etc., is even more active than can possibly be described in detail.

(2) Relation of organized system of knowledge to control.

While the control over the associative activity in thinking is limited, yet we do know that elements belonging to the same organized system of knowledge are most likely to be reinstated. When the problem is mathematical in character, the ideas which arise in consciousness are apt to be mathematical; when the problem is historical, the ideas suggested are apt to fall within the field of our knowledge of history; when the problem is one of conduct or practical life, ideas are apt to arise that belong to the particular setting of that problem. Taking advantage of this principle, we can focus our attention upon the particular field of relevancy; and the more we do this the more is the imagery likely to be limited to that field. But even then the stream of imagery in any vital thinking process, dealing with a real problem, is apt to be wider and deeper than that succession of ideas which represents the final solution. More elements of past experience have to be thrown up in the associative process than can actually be used in the final adjustment of means to ends. Many of these elements have, however, had a function to perform, they have served as intermediate points of contact for the unwinding of the skein of connections until we have come ultimately to some idea relevant to our solution; others seem to be absolutely irrelevant, like so much driftwood thrown upon the shore by the current.

(3) Conclusion as to control.

Our control over the material of the thinking process is largely a matter of limitation of the field of association through the activity of attention, of selection and rejection of elements given spontaneously through connections set up in previous experiences, and of organizing and reorganizing elements that are felt to be relevant into new wholes or in new orders of arrangement. From this point of view

the voluntary element in thinking is identical with the voluntary element in motor activities. The organization of any new voluntary act, we know, starts out with an excess of movements already possible. Of these superabundant movements some are found to be relevant and others irrelevant. Gradually the irrelevant are dropped out and the relevant are selected and organized into a definite mode of procedure which realizes our end. Without the excess, or superabundance, of movements, voluntary action would be impossible; without the superabundance of ideas furnished by the mechanism of association, thinking would be impossible.

7. Summary of the Thinking Process in Terms of the Imagination.

The activity of thinking seems to consist in doing the following things, though not necessarily separately and in order. When the mind is confronted with a problem, attention is focused upon a certain field of experience relevant to that problem. The associative process works within that field, throwing up spontaneously certain suggestions relevant and irrelevant. There is tentative judgment and evaluation of the elements presented. Those which are felt to be irrelevant are rejected and those which seem to be relevant are selected. There is further focusing of attention upon the elements selected for consideration, with resulting activity of the associative process in these directions. There is again evaluation and selection, and so on. There results finally a series of images that are held more or less definitely before the mind, which have been constructed to represent a series of steps, or order of processes, to be gone through with in order to realize our end.

8. Inadequacy for Pedagogy of the Older Accounts of Thinking.

(1) Psychology of formal thinking not vital.

Most of the older accounts of the thinking process are

cast too much in logical terms. They are the result of analysis of adult thinking processes, nay more than that, of the highly wrought thinking processes of the trained reasoner when the results of his thinking process are put into their most finished form. The syllogism is analyzed as a finished product and found to involve a definitely related series of propositions. The proposition is considered identical with a judgment. The judgment is analyzed and found to involve a comparison of two concepts, and so on. Descriptive psychology has paid too much attention to the relations existing between the ideas in that series which represents the solution of a problem and too little attention to the mental processes which led up to the attainment of those ideas and their organization and incorporation into a movement of thought which attained the solution.

It is evident from the illustrations which we have given, particularly the one from geometry, that a psychology of the thinking process worked out in terms of an analysis of the finished product (for example, in terms of the series of steps involved in the completed demonstration) ignores the dynamic aspect of this process and does violence to the true psychology of vital thinking as it actually occurs in experience. The analysis of the finished product, of the ideal and perfect organization of the thinking process dominated by the use of the most perfect technique of control,—such an analysis reveals none of the groping of the mind for relevant associations, none of the intensity of the process of evaluation, or judgment, of the ideas that arise before the mind in the associative process, none of the elaborate process of selection and rejection, none of the struggle involved in organization and reorganization of material into a definite series of steps which shall represent an organized mode of procedure. And are not these the important characteristics which we found in the actual solution of the problem in geometry? If there is this intensity of struggle in the case of mathematical problems, all of whose elements

lie within such definite and narrowly confined limits, how much more is this tension of mind characteristic of practical problems of ethics and business and politics!

The mind which follows through the series of steps involved in the finished product of thinking, as for example, in the formal demonstration in geometry, has its thinking function reduced to a process of mere assent to the connection of ideas worked out by another. The one who made the demonstration did all the vital thinking. The most vital part of all was that which preceded the formal demonstration. Any one who has worked "originals" in geometry can testify to that. The one who follows the steps of the finished product does not go through the full thinking process by any manner of means. That would involve making connections for one's self, actually working out the relation between means and end and constructing the series of steps which should realize the end.

In all this discussion of the associative process in thinking, this point certainly ought to stand out by this time very vividly and clearly, namely, that the most vital part of ordinary thinking cannot be described in terms of the syllogism nor in terms of any other highly wrought and ideally perfect mode of procedure that can be analyzed out of completed solutions of problems either inductive or deductive. Educational method and educational practice have suffered enough already from the attempt to base methods for growing minds struggling with real problems upon the psychology of the finished product of the thinking process. No analysis of the goal can ever alone supply us with the data for method, but only the analysis of the methods by which minds actually reach that goal is sufficient for this purpose. Thinking as a process controlled and directed by the use of highly wrought elements of technique is an achievement to be attained as the goal of a long process of training. And even when it is attained, it is exceedingly doubtful if there is any one who ever thinks through new

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problems in such a highly technical fashion as the syllogism represents.

(2) Logical power not attained through formal training alone.

The illustration given from geometry is only typical of what is equally true in many other school subjects. The logical, highly organized, system of thought is given directly to the pupil. We then wonder why he cannot make use of the facts learned to think out a problem which arises elsewhere to which this material would be relevant. The truth is that the pupil has not acquired any additional logical power in merely following through and assenting to the logically arranged material.

It is pedagogically most vicious to suppose that logical power of thinking can be developed except as the mind goes through for itself the whole process of solving problems. This includes the active functioning of the associative process already described, with all its tension and strain, with all its construction and reconstruction. Though models of finished thinking of course have their value, the power to think cannot be acquired by any monkey-like process of imitation. Dictation of the order of ideas and of their organization into a system, or a mode of procedure, is just as bad in manual training, in geography, in history, in science, or any other subject as it has proved to be in geometry. Some leeway for the more fluid processes of the pupil's mind must be left, if he is to receive any vital training in thinking. Just how much responsibility is to be thrown upon the pupil is a practical question that must be answered according to the exigencies of the particular teaching situation. No absolute rule can be laid down in a theoretical treatise.

(3) An objection answered.

Some objection may be raised to the preceding argument on the ground that when geometry was taught by the old method of starting with fixed logical concepts and following

through demonstrations all worked out in the text-book, many men got splendid training in thinking from the study of this subject. This is true, but it was not due to the method. Simply these minds were not satisfied to be juggled with; they felt when they accepted a proposition stated by another, and he then made another statement to which they were then obliged to assent, until a conclusion was reached in the attainment of which they had no other part than assent, that somehow or other they had been toyed with, that they had been unfairly driven into a corner. Their minds rebelled and they went out on excursions into the field of their own associative processes and worked out things for themselves, often to the great annoyance of their teachers, be it said.

Here again geometry furnishes a type of what has been true of other subjects in a less marked and apparent way. Students have gone back of the logical formulations of the text-books; they have rummaged around in the depths of their own experience until they have brought to light facts by means of which they could interpret those which they were studying and bring meaning over into them. They have not merely followed the thoughts of another, but they have gotten hold of problems and struggled over those problems for themselves, if they have really mastered the subject matter. Fortunately, the mind does sometimes refuse to be wholly tied down to the dictation either of text-book or of teacher. Also fortunately, there have always been some teachers who have never been satisfied with mere reproductions of logical formulations of text-books.

One of the strong tendencies of modern pedagogy is to emphasize in a variety of ways to all teachers the absolute futility of trying to teach logical organizations of subject matter without first psychologizing them. They must be prepared for by taking advantage of the whole apperceptive possibilities of the child. What this book is emphasizing, also in a variety of ways, is the futility for purposes of training

in thinking of applying bodily to the child's mind the modes of thinking characteristic of the trained man and supposing that the child is getting training in the thinking process. The technique of the highly finished form of thinking must itself be evolved in the struggle to solve problems. The psychology of this struggle is at least equally important with the psychology of the finished product.

9. Thinking Power not Separable from Possession of a Fund of Knowledge.

The power of thinking cannot be trained in the abstract, or in isolation from the process of acquisition of knowledge. In both of the illustrations which we have worked through in detail, it is noticeable that the possession of knowledge within the specific field,—one that of music, the other that of geometry,—was a most inevitable corollary of the part which association plays in vital thinking. Success in finding the relevant associates, the elements necessary to the solution of the problem in thought, is contingent upon their number and their organization. Also one's stock of definite and well-organized knowledge within the field of the problem is an essential factor in the judgment of what is relevant and what is irrelevant to the solution. Taking the problem in geometry for example, past knowledge is continually functioning. There is a stock of theorems and of definitions upon which one is constantly drawing. We may go further than this, and say that probably no one fully acquainted with the subject of geometry, say a teacher of mathematics, would be likely to go at the demonstration of the theorem in so indirect and roundabout fashion. He would get at the essential elements of the solution and organize it into its final form with less waste, less irrelevant thinking. He has well-defined modes of attack and a more highly specialized technique to apply in his methods of investigation in geometry.

This last point suggests a very important truth in the

psychology of thinking. Who is most likely to think most successfully in mathematics? In general, the man who knows the most mathematics and who is trained in its special technique. Who is the most likely to be successful in thinking through problems in economics, in history, in biology, in psychology, in engineering, etc.? The men who know the most about these subjects and who are trained in the technique characteristic of each. Thinking power is not an abstract and general power of the mind to be applied equally well in all sorts of situations. It is rather a function of some larger whole, varying with the degree of development of that larger whole. That larger whole includes special knowledge of fact and special training in the technique of the subject. The good thinker in mathematics may be a very poor thinker in economics or sociology, and vice versa. The habit of care in the examination of data, in the analysis of a situation, etc., may be carried over from one department to the other, but the special knowledge and the training in the special technique of one may be of little or no use in the other. The thinking process falls within systems of organized fact, as well as being a factor in the organization of material.

If these things are so, we delude ourselves when we think of such a thing as training children to think apart from the process of building up a body of knowledge. Again, there may be subjects of study which we feel are valuable because of the fact that they are specially adapted to the training of the child to think. But if the stock of ideas in which this subject deals is one which will seldom or never be drawn upon in his thinking in any other connection than as a subject of study, of what value does this training in thinking become to him? If we are to train children of any age to think, one of the factors in this process is the building up of a system of definite and exact knowledge of facts within the sphere in which the problems of thought are to arise. This body of fact must be organized on the basis of

its inner and inherent ties of connection, so far as this is consistent with the nature of the materials and with the stage of development of the child.

A large part of what Mr. James has termed "sagacity"[1] as a factor in reasoning, though not the whole of it, is reducible to the factor of knowledge which is immediately available. The author had occasion to note in his teaching of geometry that the difference in the ability of certain students to think through a problem in that subject very frequently could not be ascribed to a fundamental difference in mental or thought power so much as it could to the fact that the successful reasoner had thoroughly mastered all the definitions and previously proved theorems, so that they were immediately available for use. He does not in the least doubt that the same principle holds true in every school subject. A great deal of loose teaching which does not show results in the definite knowledge of important facts and truths mastered by the pupils is unjustifiably excused on the ground that the chief stress has been put upon the ability to think. The fact is there is no ability to think in geometry without knowing the facts of geometry, in geography without knowing the facts of geography, etc.

In pleading for a larger recognition of the vital thought processes of children in the schoolroom, we are not pleading for any diminution of interest in the process of acquiring facts, but rather for methods which make the acquisition of these facts a more vital process to the child through the demand made upon him for the exercise of his thinking power in their acquisition and organization. If this is done he will become more fluent and facile in the use of them in further situations demanding thinking. The free and flexible use of facts in the thinking process depends largely on the ties of logical connection which have previously been set up, on the inherent relationships that have been discovered in the past. Facts which are woven together by the intimate ties of connection involved in thinking during

the process of their acquisition are thus more likely to be at any subsequent time many-sided in character and to suggest more of the fundamental relevancies needed in the solution of new thought problems.

Supplementary Readings for Chapters XI, XII, and XIII

Angell, *Psychology,* Ch. 8, and pp. 245-8.

Stout, *Manual of Psychology,* Bk. 4, Chs. I and II, also pp. 84-89, 255-6.

Calkins, *Introduction to Psychology,* Ch. 15.

Dewey, *Psychology,* Ch. 7.

Titchener, *Outline of Psychology,* pp. 294-7.

Bolton, *Meaning as Adjustment,* Psy. Rev., May, 1908.

Baldwin, *Thought and Things,* Vol. I, Chs. 7-9.

This reference is for advanced students only. I include it for the sake of the functional interpretation of meaning given there.

See other psychologies for the discussions of imagination, association, and meaning.

[1] James, *Psychology,* Briefer Course, p. 362.

CHAPTER XII

THE IMAGE AS AN ELEMENT OF TECHNIQUE IN THINKING

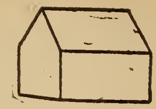
1. General Principle.

In the earlier stages in the development of thinking, the imagery is all concrete; in the later stages and in its higher forms, a large amount of abstract imagery is used. The substitution of abstract for concrete images in the thinking process is a decided advance in the direction of the development of a superior technique.

2. Our Use of the Terms Concrete and Abstract Image.

By concrete images we shall mean those that are quite faithful reproductions of sense-perceptions, whether visual, auditory, motor, or those relevant to any other sense. In the case of visual images, they would doubtless be more or less pictorial in character.

While all images are more or less symbolic in character, yet there are wider divergencies in their symbolic function from the image which is primarily re-presentative to that which is arbitrarily symbolic. There are correspondingly different degrees of abstractness of images. The term abstract is not used to mark off a class of images that are sharply differentiated from the concrete, but rather a departure from the reproductive and re-presentative character of the image in the direction of greater symbolism. The visual image house might be called concrete, if it were a reproduction, a more or less detailed mental picture, of some particular house; it might be called abstract to a certain degree if

the image were only schematic, like this,—Such an image is certainly not lacking in concrete  character, yet it certainly represents a movement of the mind away from reproductive detail toward greater symbolism. In so far as this is true the image is abstract. The image house would be still more abstract if it were only the visual image of the printed word or the auditory image of the word spoken. In these cases, the re-presentative character of the image is entirely lacking, and the symbol is arbitrary. Any other word-symbol would do just as well, provided we agreed upon it.

There can be no doubt that the thinking of trained adults goes on very largely in terms of word-images or some other form of arbitrary symbols. Mathematics affords us a striking illustration of a field in which as you go from the lower to the higher and more advanced lines of investigation you necessarily employ more and more compact arbitrary symbols in order to carry on the thought process effectively. The more precise significance of the use of abstract images can be seen to better advantage if we postpone the discussion until we have worked out something on the nature and genesis of meaning.

3. The Nature and Genesis of Meaning.

(1) Genesis of meaning.

For an illustration let us take a case of the development of meaning in perception. Suppose the child has never seen sugar. He now sees it in the form of a little cube. This cube can have no more meaning to him than any other white cube. But the child has a natural impulse to reach for the object which he sees. Vague perception is followed by reaction. As a result of the reaction process he ultimately gets hold of the lump of sugar. He gets new sensory experiences different from those which come from the smooth cubes of wood with which he has played. Perhaps he likes the new sensations. If so, they make a more vivid

impression and with repeated experiences get closely associated with the visual appearance of the cube. According to the laws of association, if either of these associates occurs alone it tends to suggest the other. Consequently, if the child gets the characteristic visual appearance, the mind now supplies, without his going through the reaction process of reaching, the characteristic quality of roughness which would result from reaching and touching. In this case the visual appearance has operated as a symbol to suggest something not given. *That which is suggested is meaning.*

Or if the touch sensation is that which is given and the mind supplies, without the child's going through the reaction of looking, the characteristic color and form; then the touch sensation has operated as a symbol and the color and form are elements of meaning. If the child has gone through play reactions with the cube of sugar, its sight or its touch may suggest these play experiences again. If the play experiences are anticipated on the basis of the data given, then they become a part of the meaning for him.

Through still other reactions having their origin in a deepseated impulse the child will almost inevitably put the piece of sugar in his mouth and thus get a new group of sensations, those of taste, which will become associated with the others. If, when the piece of sugar is seen, the visual qualities suggest the sweet taste, then this anticipation in advance of the reaction which would bring it, is a case of meaning of sugar for the child.

The genesis of meaning is, then, to be explained in some such way as this:—Reaction to data given to the senses results in further sensory experience in terms of the same and of other senses. In process of time, as experiences of this sort repeat themselves in the activity of the individual, such a firm association of the various related phases of the total experience is set up that when one of them occurs

alone it suggests one or more of the further possible developments of the experience.

The data given to consciousness on the basis of which the mind responds in terms of meaning may be either sense-perception data or images. If I see a stream of water and this perception suggests to me boating, quenching my thirst, going in bathing, in all of these cases I have meanings attached to water. My mind runs on beyond the percept water as something which affects my vision in certain characteristic ways to further results which could be secured from reactions to this thing in certain specific ways. *These anticipations are meanings.* This is equally true in the case that the water is not actually present to sense but is embodied in the form of an image, either concrete or abstract. If these anticipations follow upon the emergence of the image, then they are elements of meaning of which the image is the symbol.

(2) Definition of meaning.

From the point of view just developed we may formulate in functional terms a definition of meaning somewhat as follows: *Meaning is the mental anticipation of the outcome, or result, of reactions not yet made, but which might be made, in response to data immediately given to sense or to images arising in the mind.*

(3) Correlativity of meaning and symbol.

We can easily see now that meaning and symbol must be correlative. Each involves the other necessarily. That which is suggested is meaning, and that which suggests it is the symbol, or carrier, of the meaning. In terms of content, that which is meaning at one time may be symbol at another, and vice versa. The color and form of the object may suggest to the child the sweetness of sugar in advance of his putting it to the mouth. Again, if the lump of sugar is not seen, but is tasted only, the sweetness may suggest color and form in advance of turning the eyes upon the object. In the first case, color and form operate as symbol

to suggest the meaning sweetness; in the other, sweetness to the taste operates as the symbol to suggest the element of meaning color and form. There is no such thing as absolute symbol and no such thing as absolute meaning. The two, meaning and symbol, are correlative, but not fixed and absolute.

In every experience which has meaning for us, analysis is always capable of distinguishing between certain elements which may be regarded as given and as having little or no value in themselves, but only for what they signify, and certain other elements which are supplied by the mind and which are significant. Without meaning there is no symbol; what we call a symbol is not a real symbol, but only an empty form. It is equally true, but more difficult to understand and more easily overlooked, that without symbol there is no meaning. If we have any experience which is absolutely contained within itself, suggesting nothing not immediately given, not serving as the basis of any anticipation,—in other words, to which the mind adds or supplies absolutely nothing,—this experience may have some sensational and perhaps some feeling value, but it cannot be said to have any meaning for the person who has the experience. To connect this thought with the familiar doctrine of apperception, this is an experience of something totally new and it is not apperceived.

The element of meaning involved in experiences of recognition seems difficult to bring under our conception and definition. But even here there is undoubtedly some splitting up of the immediate experience into two phases, one of which is symbolic and the other suggested, only here the two phases are so closely related that it is hard to distinguish them from each other. When we have the experience of recognizing our friend Jackson, that is virtually mentally assuming that he is the same person whom we saw yesterday. In this case we at least supply a setting different from that of the present by way of a foil to bring out

the idea of sameness. So we may safely assume that meaning and symbol are strictly correlative. If this is true psychologically, it has pedagogical implications of considerable importance. These we shall try to point out in another place.

(4) The functional nature of meaning.

Meaning as an aspect of consciousness is functional. Our account of its genesis, as well as our definition, have emphasized this fact. A study of children's definitions, where you see meaning not yet fossilized, furnishes striking evidence of the truth of our position. Chamberlain[1] has collated definitions from several sources. A few of the most striking ones follow:

> Kiss is if you hug and kiss somebody.
> Mast is what holds the sail up top of a ship.
> Nail is something to put things together.
> Nut is something with a shell good to eat.
> Quarrel is if you begin a little fight.
> Ring is what you wear on your finger.
> Saw is if you see something, after you see it you saw it.
> Vain is if you always look in the glass.
> A dog is to have by one.
> A garden is to walk in.
> Village means one sees everybody pass.
> Flame is the power of the candle.

The truth of the functional view of meaning here presented is still further seen in the fact that meaning is relative to a given situation. When the child is hungry, an apple is something good to eat; when he is not hungry, but playful, an apple is something to roll or to throw up and down and catch. The meaning is different in the two cases because the individual anticipates from the object the satis-

[1] Chamberlain, *The Child,* pp. 146-147.

faction of a different need through, or as the result of, a different mode of reaction.

There seems to be a good deal of evidence in support of the view that the earlier and cruder meanings are functional, but will it hold true of the technical and scientific meanings of the trained man? To the child a ball is something to roll, the meaning is plainly functional; but how different the mathematician's conception! He would think of a ball as a material sphere, every point of whose surface is equidistant from a point within called the center. But his problem is very different. Because he is meeting through the ball a different need, his meaning for the ball is different from that of the child. It answers his purpose as a mathematican, it fits in with his mathematical experiences more adequately, to attach that meaning to the ball. In both the case of the child and that of the mathematician, what is anticipated is in terms of characteristic experiences that the object has yielded and is capable of yielding again. The same line of thought can be applied to all manner of meanings that get expression in descriptive terms. The writer believes that it holds equally well for the meanings of such abstract terms as justice, honesty, and patriotism also, but he does not wish to prolong this aspect of the discussion.

(5) The abstract image and meaning.

In his *Outline of Psychology,*[1] Mr. Titchener discusses the manner in which the abstract idea originates. By abstract idea he seems to mean practically what is meant in this discussion by abstract image. He describes a prevalent view of the abstract idea as analogous to the composite photograph, the various percepts of a thing corresponding to the individual pictures which enter into the composite photograph. In the resulting picture the resemblances are emphasized and the differences, not repeating themselves so often on the plate, are blurred and

[1] Pp. 294-297.

fainter. "The abstract idea of cat, on this analogy, is a reproduction in which all the cat-resemblances are emphasized, and all the cat-differences left faint and obscure. Now there can be no doubt that the abstract idea might take this form in an 'all-round' mind, a mind which was equally well developed in all its sense departments. But it is not the form which the idea does take, as a matter of fact, in the average consciousness. The photographic plate is *impartial;* it gives equal attention, so to speak, to every detail of the picture before it. The organism, on the contrary, is always biased; it gives more attention to some constituents of an idea than to others. My abstract idea of a cat, therefore, is a composite photograph only of those cat-attributes which have caught my attention; it is more like an impressionist sketch of a cat—the sketch of some particular artist, throwing into relief the particular characteristics which have 'struck' him—than like a composite photograph of some hundred cats."

This long quotation from Mr. Titchener has been introduced at this point largely for the sake of the contrast which he points out between the impartial photographic plate and the bias of the organism. This bias of the organism on which Mr. Titchener comments here incidentally is really made central in functional psychology. The organism is always biased in all its conscious processes. That bias comes from the fact that it is continually being confronted with new situations, involving new problems. The needs of the organism in its process of adaptation and adjustment to the world in which it lives make it impossible for any "all-round" mind to exist. An "all-round" mind would be hopelessly at sea in a world like ours in which a variety of individual needs have to be met by a variety of modes of individual control. No, the only guarantee that any of our conscious processes shall be of service to us is that they be fashioned with reference to the "bias" of the organism; for the organism can never be otherwise

than biased according to some situation or other. Consequently, while abstract images will be based on perception, none of them can be photographic in character. They are rather mental constructs suited to needs.

It is inconceivable that the number of teeth on the upper jaw of a steer is as important a fact to the farmer as the number of horns on its head or the number of pounds in its weight. When the farmer constructs an image to meet the ordinary purposes of his thought, the number of teeth serves no useful function and of course will not be made use of. Abstract images are tools of the mind constructed for use. How they shall be constructed, just what elements shall enter into them, depends upon the particular needs of the organism, on its particular "bias." Abstract images are symbols for the carrying of meaning. Whether they arise out of the background of concrete experiences or whether they are arbitrary inventions, the only thing that can logically be demanded of them is that they be capable of performing their function.

4. Superiority of the Abstract Image as an Element of Technique in Thinking.

(1) Less irrelevancy of suggestion.

In a thinking process, concrete images often suggest more than is necessary. They cumber the thinking process with unnecessary details. Consequently, they offer more lines of departure for the thought to run off into irrelevant channels. If, in a thinking process concerned with some problem of lumbering, the image tree arises as a necessity to the movement of thought, and this image comes with all its concrete detail as the particular beech tree at the bottom of a hill, with a cool spring under its shade, my thought may be easily switched off from its proper movement into the by-paths of reminiscences of my boyhood on the farm. But if the image is more schematic, or if it is the still more abstract word-image, the associates

suggested are more likely to fall within the field of relevancy. However, there are conditions, as will soon be pointed out, under which good thinking demands the use of concrete images. Each kind of image has its own peculiar value and function in the thought process. One superior value of the abstract image as an element of technique in thinking is certainly to be found in the fact that it affords less irrelevant suggestion for the side-tracking of the movement of thought.

(2) Greater rapidity of movement.

This same freedom from a mass of concrete detail brings with it a still further advantage. Abstract imagery flows more easily and rapidly through the mind than concrete imagery. We have only to compare arithmetical and algebraic methods of solution of the same problem to observe the superior freedom, brevity, and compactness of the thought process the more symbolic it can be made.

(3) Superiority in making logical connections.

The chief value of the abstract image, a value not separate from those already stated, is that it carries better than the concrete image those meanings which are most recurrent and general and thus makes possible the concept. The abstract image is the more likely to be a center for the correlation of meanings on which depend general and necessary connections of thought rather than those which are accidental and ever-shifting. Such an element of technique as the abstract image thus gives added power in dealing with problems involving complex and far-reaching relations.

(4) Increase of power.

To many people the term abstract is a synonym for remoteness from reality. It is true that when we get over into the realm of the abstract we are getting away from the *immediately* real and practical, but this is only for the purpose of coming back at the practical and concrete situation with added power. One who has a heavy stone to lift

appears to be getting away from his practical task when he hunts for a long pole, puts one end of the pole under the stone, places a fulcrum under the pole, walks off several feet from the stone which he is to lift, and pulls down on the pole instead of up on the stone. But as a result of his getting away from the immediacy of his task he has in reality come back to it with a tremendous increment of power. So it is with the abstract element in thought; it is only a tool for the bringing to bear added power upon the problems of life in their various forms. The whole history of science in its relation to the arts and industries of our day is sufficient evidence of the truth of this statement.

5. Functional Relation between Concrete and Abstract Imagery.

(1) Meaning of abstract image dependent on translation. Concrete images are fundamental; they lie at the basis of abstract images. Historically it is probable that the abstract symbols of written language originated in the conventionalizing of picture writing. Those who did the picture writing became accustomed to more and more abbreviated forms, until only the writers themselves, or those who were taught by them, could tell their meaning. From this it is but a short step to the idea of symbols arbitrarily chosen to represent anything we please. But it is evident that no one of these symbols could have any meaning to the person who used it unless he could translate it over into terms of that for which it stood. So it is with all the abstract images which we use in our thinking processes. In the first place, they have their origin for us either in the conventionalizing of the concrete images arising from our perception processes, or else they have been taught to us out of the stock of arbitrary symbols, mostly words, which are now the inheritance of the race; that is, they have their basis in the concrete. In the second

place, no one of these abstract images, whatever its origin may be, can have any meaning for us except as it is capable of being translated into concrete images of some sort, or else into some familiar set of symbols which we know can be so translated into the concrete.

(2) Significance for thinking.

It often happens in a thinking process that the abstract image which arises according to the laws of association which are operative fails to suggest a proper connection for the forward movement of thought. Then it becomes necessary to translate this abstract image into terms of the concrete until some meaning is found which is familiar enough to serve as a basis of effecting the necessary transition in thought. In general, the abstract image suffices when it serves the function of making connections. This it does most adequately in the realm of the familiar.

In dealing with the unfamiliar we are more likely to need to convert the abstract into its concrete equivalents. When one first learns the meaning in geography of isthmus and of strait, he quite likely has to get some sort of a concrete image in order to distinguish the two. The thinking process is blocked until the proper meanings are cleared up by translating the word images over into more concrete terms. The abstract symbols in this case are not sufficiently perfected as elements of technique in thinking. For a while they have to be translated into terms of the concrete every time that they occur. But when these terms become thoroughly familiar, thought glides on without such translation. The principle need not be further elaborated here; for it will be made clearer in the pedagogical discussion which is to follow in the next chapter.

CHAPTER XIII

EDUCATIONAL APPLICATIONS AND ILLUSTRATIONS

1. The School must concern itself with the Task of securing for the Child an Adequate Background of Concrete Experience.

(1) The principle in general.

Thinking cannot be most effective, as we have already seen, except as the power to use abstract images is developed. But these have no meaning unless they can be translated in terms of the concrete. Furthermore, some sort of thinking must go on in terms of the concrete as the starting point for the development of this superior abstract element of technique. It is, then, very important that the child have an adequate background of experience with the concrete as the first requisite of any serious attempt to train him to think. May we assume that he will get this background of concrete experience outside of the school? If that assumption was ever justifiable in the past, it is no longer so in this age of specialization of industry and of crowding of the population into the cities.

It is evident that the school has a duty to perform in seeing that the child gets a richer background of first-hand experience with things. Teachers of science have found the laboratory indispensable not alone for the purpose of conducting investigations with proper instruments, but also as a means of bringing their pupils into direct contact with things which give them the concrete images on which to base the generalizations involved in right thinking. The teachers of the grades are learning the same lesson in ele-

mentary education. Only here the need is even greater. The experience of the child must be enriched through the agencies of manual training in all its forms, excursions to the fields and the parks, the use of pictures, stories dealing with concrete situations involving principles, etc. Even in history, morals, and religion, the story element should be emphasized more strongly at first. The work of the school cannot be simply that of furnishing ready-made the great tools of further culture and knowledge,—the three "R's."

(2) Concrete experience must not be in terms of one sense only.

Psychologists have abundantly proved the variability of people in their use of concrete imagery. We do not all rely equally upon visual images. With some, auditory images are more prominently employed than the visual; and with others, motor images play a very large part. Still further, different sorts of situations may call for different types of imagery. Hence it is not sufficient in building up the background of concrete imagery on which higher forms of thought depend to employ modes of instruction which call for visual imagery alone. Forms of instruction must be devised which call into play the eye, the ear, and the hand. Oral instruction, manual training, drawing, and other constructive arts must go hand in hand with observation and books, if we are to furnish an adequate basis of concrete imagery to support the higher psychical processes. We must be fair to the ear-minded and the motor-minded (may I say hand-minded?) types of people. We must also provide the concrete imagery material for the right understanding of situations for which one kind of imagery is not adequate. Otherwise thought is crippled and goes hobbling along on one foot.

2. Attention must be given to the Translation of the Abstract in Terms of the Concrete.

(1) Such translation is often the determining factor in thinking.

We have seen that there is a functional relation between the concrete and the abstract. This relation can never be absolutely broken down after abstract images have been developed. The whole meaning of the abstract is dependent upon the ability to translate it in terms of the concrete. This ability is often the determining element in the solution of a problem of thought. While thinking moves more rapidly and also with greater power in terms of the abstract imagery, yet at critical points the whole success of the process depends upon the ability to translate into terms of the concrete. This would be another argument for the point made above, namely, the need of a sufficient background of concrete experience. But, to return to the particular point under discussion, we can easily see how a general, working out a plan of campaign, might be stuck at some point while working in terms of the map; but if he had some considerable experience with the country in question, the solution of his problem would be simplified by stopping to recall certain characteristics of strategic points in all the concrete detail of reproductive imagination.

Children who fail to solve a certain class of practical problems in arithmetic are often unjustly regarded as stupid or incapable of thinking. Frequently the difficulty is not to be traced to any fundamental weakness in thought power as such, but rather to inability, or failure, to translate the abstract terms of the problem over into concrete terms. Such is the case with many children who have trouble with problems in papering, plastering, bricklaying, carpeting, etc. The minute that they get a clear idea of how strips of carpet look upon the floor, of how bricks look in a wall, etc., then the problem becomes quite simple.

The translation of the abstract statement of such problems into terms of the concrete may often be facilitated by requiring the pupil to supplement, or make explicit, his image by means of a drawing. His chief difficulty has been that he actually could not mentally see how carpet looked upon the floor, or paper on the wall, or boards in a fence around a field. From the point of view, however, of training in the power to think through rapidly and skilfully this class of problems, the permanent necessity of translating the abstract formulation into concrete terms would be far from ideal. Ultimately these problems should be quickly and readily analyzed into their essential elements, their relation to some fundamental principle, or general method, seen, and the work done by the appropriate rule.

It is not alone in mathematics that thinking power often depends upon the ability to translate quickly from the abstract formulation of the problem over into the concrete. Many a problem of sociology, of economics, or of practical life, notably in matters of conduct, can be adequately grasped only by repeated translations into terms of concrete and specific situations. The man who can make these translations with the greatest facility is often the man who arrives most quickly and most certainly at the right conclusions.

(2) Practice in translation must be given.

In all training to think, the functional relation between concrete and abstract imagery must be kept unbroken. There must be the adequate background of concrete images derived from abundant first-hand experiences of the right sort to serve as the basis of translation of the abstract into the concrete; and there must be sufficient practice, at the time of training, in the habit of making such translations at critical points in the thought process. This habit is an important asset to thinking power. It often marks the

critical difference in the mode of attack of a new problem by the successful thinker and the unsuccessful.

(3) Practice in translation makes abstract images more efficient.

A still further reason for giving practice in the translation of abstract terms over into the concrete is to be found in the fact that it makes the abstract images themselves more fluent and facile as tools of thinking. There is a feeling of warmth and relevancy to the concrete images which gradually gets transferred to the abstract. The meaning of the abstract becomes an indissoluble part of it, immediately felt and appreciated, needing not to be consciously and reflectively unfolded in order to perform its function readily, accurately, and adequately. In other words, practice in translation does away with the need of translation through the transformation of the abstract which has been effected by the process.

It is doubtful if teachers fully appreciate the value and importance, especially in the early stages of the pursuit of a new subject, of abundant drill in the matter of translating the abstract in terms of the concrete, or of the more abstract in terms of the less abstract and more familiar. This applies particularly to mathematics where so many important general principles and rules are expressed in terms of formulæ. These formulæ cannot become real tools of the mind, fully adapted to the solution of new problems, except as they have been fully appropriated and assimilated and worked over into the very texture of the mind itself. This means that the functional relation between these abstract elements and their concrete equivalents has become so very close that it is immediately felt and appreciated rather than being explicitly thought. Now, every branch of study moves in the direction of more or less abstract formulation of thought. Its formulæ may not be so compact as those of mathematics, but they are often more complex, as in economics, sociology, psychology,

ethics, and religion; hence flexibility, freedom, and power in their use demand abundant practice in their translation into concrete terms.

3. Training in Thinking demands that the Transition bé effected from the Use of Concrete Images to the Use of Abstract Images.

The preceding paragraphs have emphasized the importance of the concrete. But from the point of view of thinking power the abstract image is the more powerful tool of thought. While it is necessary to emphasize the concrete for the sake of giving fullness and richness of meaning to the abstract, yet it is also necessary to pass on to the free and flexible use of the abstract. Along with the development of the habit of translating the abstract in terms of the concrete should go the training of the power to translate and sum up the concrete in terms of the abstract. It may be all right for the child of five to count upon his fingers, but it cramps his mental growth for him to be allowed to continue to do so after this practice has performed its function of getting him started. In the case of the problems already mentioned of papering, plastering, carpet laying, etc., the teacher would fail in the performance of his full duty if he did not lead the children on beyond the necessity of working out all the problems in the concrete.

For the small child it may be all right and even necessary for him to think of law in the concrete terms of the policeman and of God in terms of a big benevolent man; but growth in the power of intelligent thought along these lines demands the development of the power to think in more and more abstract terms. If we fix the child in the habit of thinking in terms of the concrete by giving him practice in the concrete beyond the necessity of furnishing a sufficient background for the attainment of fullness and richness of meaning for his abstract symbols, we are limiting his possibilities of becoming strong and powerful in

his thought processes. Particularly as the period of adolescence draws near should more attention be given to the cultivation of thought in more abstract terms.

4. The Child's Ability to give Formal Definitions of Things is not a Proper Test of his Knowledge of their Meaning.

We have already seen that meaning is primarily functional in nature. The child of the lower grades has not passed over into that stage of development in which meanings take the more structural and descriptive forms of science. If we wish to know whether he understands the meanings of words used in his reading lesson or in any other subject, we should be reasonably well satisfied with answers in functional and concrete terms. It is more or less waste of time for the teacher to be too insistent upon definitions in the abstract and descriptive terms which would be required to satisfy the adult mind.

5. There is a Real Danger that Education may become a Process of Juggling with Symbols.

(1) Value of learning dependent on grasp of meaning. We have emphasized the fact that symbol and meaning are correlative. When the child is taught in such a way that he gets a symbol without meaning, psychologically it is no symbol for him, even though it be for us. The value of the symbol for the teacher is not the sole basis for teaching it to the child. It is necessary to develop along with it the correlative meaning. If the child is not ready for this, or if it cannot be done, then the symbol should not be taught. The learning of beautiful memory gems, of catechisms, of Biblical verses, etc., is of very doubtful value, unless much attention is given to the problem of developing their meanings in terms comprehensible to the child. The doctrine here laid down is only another phase

of the discussion centering in the functional relation between abstract and concrete imagery.

(2) Application to reading.

Fluency in reading,—the ability to pronounce hard words and to control the other elements of technique involved in the reading process,—is no guarantee of the assimilation of thought by the reader. Some children have a fatal facility in the handling of symbols. This facility must not be taken as a measure of the grasp of the meaning, or content, of what is read. It is not safe to assume that children understand without taking some trouble to test. And the verbal test is not always sufficient. Dramatization, drawing, and constructive work are more certain tests where they can be applied. Reading means intellectual death if content is ignored and the process is reduced to one of drill upon the manipulation of technique. The writer has had opportunity to observe quite widely, and he believes that there is a very real danger that reading may become too much a process of juggling with symbols.

(3) Danger of loss of interest.

The process of learning symbols without sufficient attention to meaning leads either to loss of interest or to artificiality. A certain child who had natural facility in reading undertook to read Shakespeare at an early age. He found little difficulty in handling the technique of the reading process and took a certain pride in his achievement. But after a time, the whole thing began to pall upon him because it all seemed such senseless stuff. The result was that he studiously ignored Shakespeare until he became a young man and was required to take up the reading in higher English courses. Another young man said that he thought that he might be able to enjoy Tennyson's "The Princess," if he had not been put through such a stiff drill in analysis of the poem. Mastery of technique at the expense of meaning was deadening in both of these cases,

and these can be duplicated times without number in actual experience.

(4) Danger of artificiality.

Learning processes which begin as juggling with symbols we would naturally expect to die out quickly from lack of motivation. On account of their barrenness, they should normally be the cause of their own cessation. But they are often kept up through the pleasure found in the activity itself. When this is the case the outcome is the most pitiful kind of artificiality, judged from any true standard of the real nature of thinking. The classic illustration of this is to be found in the arguments of the Sophists as they are represented to us in Plato's Dialogues.

But we do not have to go so far away from home as ancient Greece to find abundant illustrations of the same thing. For how many students have algebra and geometry been little more than processes of successful juggling with symbols! They passed in these subjects, yes, but how much of meaning or significance did they have for them? It was rather fun to manipulate the plus and minus signs in algebra, making changes according to the rules, and to come out at the end of long processes of reduction with the answer given in the book. But what of it? What did it all mean? And so in geometry it was rather interesting to find that if you drew a line through a figure in a certain way, a lot of statements could be made which would be true and which would lead to a certain conclusion. But why draw the line? That was arbitrary; the author said to draw it. How deadening to real vital thought processes to deal with a lot of arbitrary elements when every one of them can be made to carry a rich load of meaning! The teacher should not rest satisfied until meaning is correlated with symbol.

(5) Extent of this danger.

This danger of making instruction a process of mere manipulation of symbols is not confined alone to reading

and mathematics. It is just as likely to occur in the teaching of geography, of grammar, of physics, of chemistry, etc. Certainly much of the imagery of adults of the present age who studied geography in their childhood is in terms of dots and lines on maps rather than in terms of anything that is concrete and meaningful regarding places and things. We are doing much to remedy this in present-day education. We cannot do too much in the direction of furnishing a basis in concrete studies for the meanings of the symbols of our more abstract sciences.

CHAPTER XIV

DEVELOPMENT OF THE IMAGINATION IN RELATION TO THINKING

1. Stages of Development.

We are familiar with the thought that the life of the child passes through several stages of development the phenomena of which are different enough to attract the attention of the investigator. But the facts of child life are not to be viewed as mere facts, however interesting they may be. If child study is to have any real significance, the body of facts which it studies must receive some consistent interpretation. There must be some standard of their evaluation. The standard of evaluation and interpretation is furnished in the idea of *growing control.* The phenomena of child life must be interpreted in terms of their functional significance in the process of growing control.

For convenience of discussion we may divide the period of prolonged human infancy into the following periods: (1) early infancy, from birth to about two years or two and a half years of age; (2) later infancy, from the end of early infancy until six or seven years of age; (3) childhood, from six or seven until twelve or thirteen; and (4) adolescence, from the end of childhood until maturity. In the discussion of these stages of development we must not think of them as sharply separated from one another, but as continuous and overlapping. That which is stated as significant of a certain stage of development must be thought of as having its beginnings in the preceding stage and as continuing over into the following one. We are

not going into a full discussion of the characteristics of these stages of development, but shall take up some of the things which throw light upon the place and significance of the thinking process in the life of the child. The stress will then fall upon the development of the child's imagination from the point of view of the problem of growing control.

2. First Period,—Early Infancy.

This is a period preëminently of beginnings. The child is largely concerned with the mastery of the fundamental physical coördinations. The larger muscular movements are brought under control, including the fundamental coördinations involved in walking and talking. Objects are of interest to the child mainly as centers of reaction. Upon them he can exercise his growing power of manipulation and control. They are things to be pushed and thrown. They are the instruments of securing interesting sensations,—tactual, visual, auditory, muscular, etc. They have immediate and direct value. Activity is interesting in and of itself. It has little of definite aim. The child's play is more physical than intellectual. The objects upon which it expends itself have an emotional significance as furnishing a field for the pleasurable exercise of his growing power of physical control.

In the child's abundant and more or less impulsive and spontaneous activities in this period, he has acquired various experiences which serve as the basis of the dawning imagination. His control over objects and his own acts in relation to these objects has grown in proportion as he has remembered the results of past experiences and utilized them in further manipulation.

3. Second Period,—Later Infancy.

(1) General characteristics.

In later infancy imagination comes into full bloom. The efflorescence of the imagination and its correlative expres-

sion in spontaneous play is one of the chief characteristics of this period. Both the activity of imagination and the development of play are stimulated by the fact that this is a period of the freer use and control of the larger muscular coördinations effected in the earlier period and also that a beginning is made in the control of finer muscular coördinations. Another of the chief characteristics of later infancy is that it is the period of making the fundamental social adjustments. The significance of the kindergarten lies in the recognition of these fundamental tendencies of child life in this period and the endeavor to guide and direct them to a richer fruition. But our discussion must revert to the imagination, however interesting it might be to follow up other leads.

(2) Activity of the imagination in play.

The period of later infancy is the golden era of the imagination. There are many ways in which this is evidenced. One of these is in the play activities of the child. Whereas in the earlier period the child's play was a more or less direct response to some object which he playfully manipulated, or it exhausted itself in the exuberance of physical activity itself; in this period play is more the response to images in the mind, and the object is reduced to a subsidiary position. The chair is not pushed to and fro merely for the sake of the pleasure of the exercise of physical control involved in the manipulation; but it has now come to be a train of cars, a wagon, an engine, or what not. The thing that is primary is the image in the child's mind; the chair is reduced to a vehicle for the expression of that image. Image and play are correlative. They are related to each other as stimulus to response, or as inner to outer aspects of the same process. The image without movement would be very fleeting and evanescent; movement helps to define and build up the image.

(3) Significance of rapid development of imagination.

If we are to employ our category of growing control,

this rapidly developing imagination is significant from several related points of view. For one thing it marks a movement in the direction of mental as contrasted with purely physical control. However, in this period the image is not felt to be distinct from the act. Image and act are not discriminated, but are aspects of one emotional whole. Again, a part of the wonderful activity of the imagination during this period can be interpreted as the inevitable consequence of the exercise of a new power. There is always pleasure in the exercise and control of a new function. The activity of the imagination in its early stages of development is its own stimulus and its own reward.

(4) Enlargement of field of control.

The activity of the imagination enlarges the field of control. During this period the child is preëminently seeking to enlarge his experience. The present moment is not an isolated fact. Through memory and imagination it becomes a part of a larger whole. The absent features of this larger whole may be supplied to the intense emotional satisfaction of the mind. The common objects of play thus become centers for the condensation of limitless possibilities of experience which the child could not realize in any other way than through play. Time and space become soluble and his sphere of control is indefinitely enlarged. The fact that the fire engine passed an hour ago and is now miles away does not remove it from the sphere of the child's activities and the exercise of his control. The chair becomes the fire engine and the interesting experience is prolonged and repeated in the absence of the particular thing which originated it. In imaginative play everything in heaven above and earth beneath is brought under the control of the child and is manipulated by him. He is monarch of all he surveys, and time and space furnish no limitations to his empire. There is nothing which the child cannot have, if he will,—drums, stores, soldiers, wild animals from the desert and jungle, etc. There is nothing

that he may not be from the coal man or baker to the king. Everything yields to his control. The world is free and plastic, to be moulded at his will. In imagination he can satisfy to the full the natural impulse for power and control.

(5) Unification of experience through imagination.

The nature myth appeals to the child, as to the primitive man, largely for the reason that the interpretation which it gives of the facts of nature brings them within the world of his experience and makes more intelligible to him the sun, the moon, the stars, wind, thunder, lightning, the echo, etc. In the myth they cease to confront him in all their mysterious isolation and out-there-ness. Through his imagination they have been brought into his experience and have been made emotionally congruent with the other facts of his experience. By means of the myth gaps in the imagination, as it seeks to grasp related facts as one whole, are filled and the tension of the mind due to these gaps is relieved. Take for example the experience of primitive man with the sun. He sees it rise in the east and set in the west. It then vanishes from his view, reappearing in the east the following morning. But the imagination is not satisfied with this break, or gap, in the experience; the mind seeks to fill it in. The formation of the myth that the sun is carried around the rim of the disk-shaped earth in a boat from the west to the east fills in that gap and gives unity to the otherwise isolated facts of experience. The myth serves the same function for the child as for the primitive man. Through its agency discordant elements of nature are woven together into a system, and a fundamental impulse toward unity is satisfied through the activity of the rapidly developing imagination. This unity may dissolve again at various points and have to be reconstructed, but it is nevertheless significant that a system of relations has been set up at all. The existence of such systems of relationships, crude and even erroneous though

they may be, is a necessary prelude to the emergence and development of the thinking process. Thinking does not in the first place set up relationships, but it works within a system to define and reconstruct and make explicit relationships within that system and to take advantage of them in consciously determining modes of action in problematic situations.

Through play, myth, and fairy story the imagination of the child is called forth and exercised. It is given flexibility and power. It receives practice in the organization and use of imagery, which is important for every phase of the higher psychical processes. The first mental wholes are built up which serve as the basis for further analyses and syntheses on which higher development depends. But the characteristic of the imaginative activity of this period is that it is dominantly a process of enlarging and knitting together the child's experience through the building up of mental wholes which are more emotional and personal than intellectual.

(6) Lack of reflective element.

That the intellectual or reflective element is not characteristic of this period, at least until toward its close, is seen in several phenomena of child life. One of these is the lack of organization in games. The small child, for example, enjoys playing hide-and-seek, but he is scarcely hid before he comes running out to be found. The pleasure of the game is in large part the activity itself and the excitation of the imagination. Some of the so-called lies of children are undoubtedly to be explained on the basis of the lack of the reflective element and the predominance of the emotional in the imagination. The distinction between that which is in the mind and that which corresponds to external reality has not been fully made. We adults have had so much practice in distinguishing between our percepts and our images that we rarely go wrong in the matter. But when the imagination is developing very rapidly and its

phenomena are more or less new, untrained, and undisciplined, this distinction may not be so evident. How should the child know anyway in advance of abundant experience that what his eyes give him is more reliable than what his imagination gives him? As immediate experiences both are equally real, only one stands further tests better than the other. Because of this fact we have become accustomed to note the difference between the two experiences and to distinguish them. And it is all simpler to us than to the child.

(7) Distinction between means and ends felt rather than conceived.

In this golden era of the imagination characterized by spontaneous play, the image and its expression are integral parts of a relatively undifferentiated whole. To have the image is practically the same as responding to it. Process and product of activity merge and interpenetrate. There is not a separate value in consciousness for each. The process has not become subordinate and the product primary. That is why we call the activity play. The distinction between means and ends is not intellectual, though it may be emotionally felt. Without this distinction there can be no clear recognition of a problem, nor can there be any such thing as conscious adjustment of means to ends. This is not saying that there is no thinking at all in this period of childhood, but merely that the thinking process is not strikingly characteristic. A two-year-old child lost his ball in the capacious seat of the Morris chair. He tried to reach it from the front of the chair. Then he tried to get it from one side. Failing in both these attempts, he stopped and looked carefully, after which he went directly to the point of nearest approach and seized the ball at once. Was there not a thinking process of some sort involved here? Did not the child consciously adjust means to an end?

(8) Thinking not the characteristic type of consciousness.

In the abundant play activities of the child there must be

numerous occasions for the conscious adjustment of means to ends. We are more likely to underestimate than to overestimate the amount of thinking that is done by the small child. Yet thinking is not the characteristic type of consciousness in this period. The distinctive thing is the freer, more spontaneous, and emotionally toned imagination Thinking cannot receive rapid development without being preceded by a sufficient exercise and development of the imagination to make easy and natural the distinction between means and ends. Much can be done in the plays and occupations of the kindergarten to prepare for and to introduce this distinction. The function of thinking has already begun to be performed in a crude way quite early in the life of the child. In this period of rapid development and efflorescence of the imagination, the forward movement in the development of thinking is in the direction of bringing to consciousness the distinction between means and ends. Yet this should not be unduly hastened. It may be that the stimulation and development of the imagination will be found to be the more important.

4. Third Period,—Childhood.

(1) Development of conscious distinction between means and ends.

In the second period the child has gotten considerable freedom of control over the larger muscular coördinations. The third period is characterized on the physical side as one in which he is getting control of the finer muscular coördinations. At the close of this period the boy is pretty compact and well knit, with excellent control over his physical powers. In running, leaping, wrestling, climbing, etc., he is nimble and skilful and flexible. As the child's power of manipulation and motor control have been increased through bringing into subjection the finer muscles, he has been led in the increased variety and complexity of his reaction processes to distinguish more sharply between

means and ends. The more complex the reaction processes, the more likely it is that some of them will be seen to be subsidiary and subordinate, and activities will not loom up so large in consciousness for their own sake but for the sake of their results. Thus arises the conscious distinction between means and ends.

(2) Development of symbolism.

Another way of expressing this same thought is to say that the image is becoming a symbol. The image which comes into the mind is no longer merely an inseparable phase of an activity. Images are less direct in function, response is less immediate; and the images serve more of a mediating function. Imagination ceases to be so blindly impulsive, and images serve to guide and direct activity through a series of steps. As a consequence the objects around which the child's activities revolve cease to be mere centers of immediate reaction as in the first period; nor do they, as in the second period, serve to the same extent as media for the direct expression of the images in the child's mind. Through the growth in the power of symbolism, the steps in a process of complex reaction can be imaged without the images passing over immediately into their corresponding acts. The image is not now an inseparable and indivisible part of the act, but it may stand for an act which may or may not take place. It becomes symbolic of some phase of the process or of the result of that process. The conscious distinction between means and ends involves the symbolic function of the image. *On the side of mental development in this period of childhood, the growth of the power to distinguish between means and ends, or the development of the symbolic function of the image is the most significant characteristic.*

(3) Distinction between means and ends practical rather than theoretic.

It must be remembered, however, that in this period the symbolism of the image works within quite *concrete* situa-

tions. The end to be realized is most appropriately what we might call a *result* rather than some abstract end. The interest of the child is largely *practical*. While, of course, we expect to lead the child toward an appreciation of theoretic values, the dominant practical interest makes necessary a point of contact in some concrete situation. The love of tools on the part of the child in this period of development is an expression of two things,—one the symbolic function of the image, whereby he is able to distinguish between means and ends; the other his interest in concrete results and the activities which center in them.

(4) Development of thinking power.

With the rapid growth in the power to distinguish between means and ends, we should expect a correspondingly rapid expansion in the field of the child's thinking. If we conceive of thinking as the process of conscious adjustment of means to ends, then the thinking process is certainly furthered through growth in the power to distinguish clearly between means and ends. In fact, no thinking is possible without some degree of the development of this power.

(5) Training in thinking.

As the period of childhood roughly corresponds to the period of elementary school education, our problem at this point becomes, What can the elementary school do in the matter of training the child to think, and how can it do it? If the child is to be trained to think he must be given opportunity to consciously adjust means to ends. But the emphasis must fall upon those types of situation in which the ends are *results that are quite definitely related to processes from which they spring*. All the manual training and industrial activites are from this point of view especially valuable as furnishing the right sort of problems. In geography there is the opportunity to emphasize valleys, rivers, mountains, cities, etc., as the outgrowths of certain processes. They are results, definite and concrete, of

activities which are perfectly relevant and comparatively easy of comprehension because of their concreteness. A valley, for example, may quite easily be seen to be the result of certain processes. It has an explanation. The child can see even now that erosion is going on at some points and deposit of soil at others. In the light of certain present concrete causes and conditions he can work out the process by which the valley came to be what it now is. In doing this, he is mentally adjusting means to ends, but this he is doing *within a particular concrete whole.* But in doing this repeatedly with many concrete wholes, *he is forming a habit of looking upon things as explainable by reference to principles.* Thus he will ultimately come to the appreciation of principles and laws themselves. In nature study also, it is easy to correlate cause and effect in a multitude of simple situations. In history this is a little more difficult, requiring more effort of the imagination, but here much can certainly be done in the way of cultivating the habit of thinking of the institutions and modes of life with which we are familiar as the outcome of certain preceding processes. *The child is more interested in seeing relations within a particular whole than in seeing broad and sweeping generalizations. His training in thinking should begin with a pretty concrete consciousness of results and the means to secure them, from which should be gradually developed a more generalized sense of the relation between means and ends.* This would culminate in the formulation of rules rather than principles. The child may reasonably understand the "how" if not the "why." I say *understand,* not merely *know. Understanding* the "how" implies a consciousness of the relation between the means and the end within a particular whole, at least; *knowing* the "how" may be a purely blind process, which is from the child's point of view wholly arbitrary.

The child in the grades should be so trained that before he leaves he has acquired the habit of not taking things as

mere brute facts, but of thinking of them as having a background, a setting, a context, as being the results of certain conditions and causes, as belonging to some system or other, and as finding their explanation in some set of relationships within a larger whole. Here is abundant scope for the exercise and development of the power of wider generalization and genuine appreciation of abstract principles and laws which make possible the larger unifications of experience. Give the practical interest of the child full and free satisfaction, and you furnish a dynamic basis for the development and rapid expansion of the reflective interest which is more characteristic of adolescence.

5. Fourth Period,—Adolescence.

(1) Striking characteristics.

The early part of the adolescent period is known as one of rapid growth. Physically it is a period of muscular and functional reconstruction. It is normally a period of abounding energy and exuberant vital spirits. But it is also a period in which the individual is confronted anew with the problem of muscular coördination and the learning over again of forms of control previously perfected and adapted to his earlier size and strength. The suddenness of the new access of bulk accentuates in consciousness his mal-coördinations and may have something to do with making him more reflective.

More significant than the growth processes themselves, however, is the coming to consciousness of new instincts. Through the ripening and sudden emergence of the sex instinct, the youth is made conscious that the period of childhood has come to an end. The emergence of the sex factor in consciousness is not merely physical in its significance, but even more social. It emphasizes two things: (1) that the individual has come to a period of independence and (2) that he is a part of a larger social whole than his own family. As a result of the first emphasis, he is

likely to rely more upon his own judgment; as a result of the second his interest is suddenly aroused in the larger problems of human life.

The adolescent is looking out upon a new and larger world in which he feels that he is soon to play a part. It has a new interest and significance for him. This broadening social interest reflects itself in a new appreciation of literature, science, religion, history, and sociology. It is natural that everything that throws light upon the big outside world which looms up so near him should make a powerful appeal to his imagination at this time. Adolescence is a period in which the individual is seeking to find himself and to get into touch with the larger social whole of which he is becoming conscious that he is a part. He is confronted with the problem of adjustment to life. Consciously or unconsciously he is feeling for his adaptation. Hence, from the pedagogical point of view, the high school period is preëminently not one of narrow specialization in one field but of the further development of many-sided interest, in order that the individual who has been living the narrow life of home or immediate neighborhood may find out his right adjustment to the larger social and industrial world.

(2) Rapidly developing interest in generalizations.

We are not here concerned with working out in detail the psychology of adolescence. But it seemed necessary to sketch a few salient features to give an appropriate setting for our account of the development of thinking in this period. It is inevitable that the rapid emergence and development of new interests and new problems of a wider scope should make the adolescent more reflective than the pre-adolescent. In his new sense of independence and personal responsibility, he is more likely to reconstruct his experiences along every line consciously and reflectively. He must take account of stock and know where he stands. This, together with his broader outlook upon life, makes

more emphatic his consciousness of the need of fundamental principles and laws. Hence there develops a new and keener interest in, and appreciation of, great generalizations. Things which previously appeared to him to be mere dry abstractions may now become of absorbing interest because they serve a useful function in organizing and interpreting the larger world in which he is now interested. Specialization and perfection of technique necessary to reach the more abstract and farther reaching generalizations now has a natural motivation in the consciousness of the new needs to which they are relevant. Pedagogically this means that the high school period rather than that of the grades is one for the organization of the various subjects of study in a scientific form, with emphasis upon the general and abstract principles involved and also upon the logical connections of the subject matter.

(3) Thinking becoming reasoning.

All that we have just said may be expressed in terms of the development of the power of thinking by saying that *this is the period of more reflective thought and of reasoning.* Without saying that there is no reasoning in the earlier periods, it is true that the thinking of the pre-adolescent is more concrete and immediately practical. It is a process of working through the relations of some concrete whole involving within itself a general principle which is grasped and comprehended through its immediate setting. The adolescent develops more power of appreciation and of understanding of abstract laws and principles. Relations within subject matter are traced out by means of these general principles, and hence the organization of knowledge becomes logical and the process of thinking becomes reasoning. The change is like that of passing from concrete geometry to demonstrative and rational geometry; or it is like that involved in passing from manual training and domestic science to physics and chemistry. In fact, these very transitions made in passing from the graded school to

the high school have their psychological justification in the development and crystallization of the child's mode of thinking into the adolescent's wider and more universal type of thought, characterized by an appreciation of the more abstract elements of technique. These elements will be taken up in detail later, hence we may drop the discussion of the stages of development at this point.

Supplementary Readings for Chapter XIV

King, *Psychology of Child Development,* Ch. 13 and Ch. 15.
Dopp, *The Place of Industries in Elementary Education,* Ch. 4.
Chamberlain, *The Child,* Ch. 4.
Kirkpatrick, *The Fundamentals of Child Study,* Ch. 13.
Sully, *Studies of Childhood,* pp. 35-52.

CHAPTER XV

THE CONCEPT AS AN ELEMENT OF TECHNIQUE IN THINKING

1. Genesis of the Concept.

We are emphasizing the functional nature of consciousness. From this point of view, specializations of consciousness are a phase of the process of attaining a more specialized and highly controlled mode of activity. And this more highly specialized mode of activity is for the sake of meeting the needs of the organism more adequately. Now the child has very few specialized modes of activity for meeting his needs at the outset. But he has strong and insistent natural impulses which inevitably drain out into action.

In the process of his activity, the child comes into relations with many things. Some of these satisfy his impulses. He seeks to come again into relations of the same sort with these things. There is a premium, as it were, put upon his noticing and remembering them. With repeated experiences, his image of anything that meets his needs is sharpened and defined. Certain characteristics stand out as marks of identification. Thus he comes to recognize his mother's face and distinguish it as an important item which stands out from the vaguer background of his consciousness of things. This is one of the things that has come to have meaning for him. On the basis of its appearance, he anticipates certain agreeable experiences. When he reacts on the basis of his anticipations, he finds that he is not disappointed. His anticipations are realized. Reactions, which were once purely instinctive or impulsive in character, have

yielded results in consciousness which are associated with this one face. The face thus has become a symbol for the suggesting of certain meanings, and the suggesting of these meanings is the basis, in turn, for certain reactions rather than others. The child has begun to have a *concept of his mother.*

The child has a natural impulse to play. Among other things, his play activities bring him into contact with what we call a ball. His reaction to the ball causes it to roll, and this interests him. He comes repeatedly into contact with round things, and as a result of reacting toward them, he finds that he gets this agreeable experience of causing them to roll. Round thing comes to symbolize rolling. The child has learned what to anticipate from round thing, and on the basis of this anticipation he has a definite mode of reacting toward it so as to satisfy his play impulse. In other words, the child has formed the *concept ball.*

The genesis of the concept, it is evident from the illustrations, is a phase of the process of more delicately adjusting action to the satisfaction of our needs, or impulses. In this process of more perfectly controlling our actions to realize ends, even though these ends are themselves first organic rather than ideal, we find that *certain classes of experiences can be repeatedly anticipated from the same thing* and that in dealing with that thing most advantageously we must employ certain methods of reaction. This is the case of the child with his mother. The concept is *individual* in character. In the matter of realizing certain other needs, or satisfying impulses, we find that among objects having certain characteristics, *one is just as good as another.* And when we meet with an object having that characteristic we react toward it in a certain way to satisfy our impulse, that way being the same for all the objects having this characteristic. This is the case of the child with the ball. The concept is *general* in character.

The illustrations emphasize what we believe to be true of

the genesis of all concepts. They normally arise in the process of activity, and they function to more delicately adjust that activity to the meeting of needs. A meaning, or a core of meanings, gets attached to a single thing or to every individual in a whole group. On the basis of some characteristic of the thing, either present or in image form, the meaning recurs to consciousness and action is accordingly determined. Our discussion of the genesis of the concept emphasizes two aspects,—one that of suggesting meaning, the other that of controlling reaction. We shall now take these up separately and try to sharpen our idea of the concept.

2. The Concept in Terms of Meaning.

(1) Meaning and concept.

In the illustrations given, as well as in our previous discussion of meaning, we have seen that there is a natural tendency, or law of mental action, that experiences resulting from the reactions to the same thing should become closely associated with each other and with the object itself. The same is true in the case of different individual objects, provided that we get from them all the same kind of experiences. So thoroughly are the special characteristics of the object and the experiences which it has yielded in past experience organized into one system that it is possible for any one element which appears before consciousness to reinstate the others, that is, it becomes the symbol which suggests a body of meanings. *An image which thus condenses experiences, or is the symbol for the carrying of meanings, performs the function of a concept if it attaches these meanings uniformly to a single thing or to every one of the individuals of a class.* The image itself may be either concrete or abstract, provided it operates as a symbol to suggest something beyond itself.

When the meaning is thought of as characteristic of a single individual, as in the case of the child with his mother,

we call the notion an *individual* concept, or individual notion. Thus, if I have in my mind an image horse which operates to reinstate in my experience the particular group of characteristics and qualities which go to make up my horse Ben, who is large and gentle and loves to be driven rapidly, then the concept is an individual concept. The proper names which grammar recognizes are the expressions of individual concepts. When a meaning, or core of meanings, is thought of as equally applicable to every individual of a group, as in the case of the child's notion ball, the image which carries the meaning is performing the function of a *general* concept, or general notion. Thus, if the image horse which I have in my mind suggests the core of meanings,—domestic animal, used for driving, etc.,—which I am applying equally to all the animals of a species, then my concept is general. The common nouns of grammar represent general, or class, concepts as a rule.

(2) Definition of concept,—in terms of meaning.

Writers vary considerably in their use of the term concept. Some use it wholly in the sense of a general notion; others speak of both individual and general concepts. But even in the case of the latter writers where the term concept is used without any qualifying adjective it will usually be found that they have in mind what they have defined as the general concept, or class notion. When a class notion is not meant, there is a strong tendency to use the qualifying adjective and say *individual* concept to make the meaning explicit. We shall follow this usage, meaning, unless otherwise specified, by concept the *general* notion.

Our definition of concept as ordinarily understood would then take the following form: *The concept is an image functioning in such a way as to suggest a definite meaning, or core of meanings, which the mind attaches equally to all the individuals of a group, or species.*

It must be borne in mind that by individual is not meant a person, nor necessarily a concrete thing, but that there

may be individual events and individual qualities and individual truths.

(3) Image and concept.

Many students have difficulty in understanding the functional view of the concept on account of their identification of image with concept. The image is essential to the concept, but it is not itself the concept. The concept is general, the image is always particular. There has been much futile discussion as to whether there is any such thing as a general image. There are of course abstract images, but there are no general images. The *function* of an image may be general, however, and that is the case with the image aspect of the concept. Image and meaning are two indissoluble aspects of the concept. Image alone is not a concept, the image must *work,* it must *do* something; and that which it must do is to suggest meanings and apply them to the individuals of a group. The same image might function in some other way and constitute a memory experience and not a concept at all, that is, it might function so as to build up in the mind a particular event of the past with enough of its concrete setting to identify it as real, as belonging somewhere in the stream of my past consciousness. Or it might function as reproductive imagination, reinstating some fact or event free from its setting in the past. Whether we have a concept or not is to be determined, then, on the basis not of the kind of image that we have in our mind but by what that image *does,* by what it symbolizes.

The image which functions in the concept may be either concrete or abstract, but it is pretty likely to have some degree of abstractness. It is evident from our previous discussion of abstract images that they are better suited than concrete images to do the work of the concept. They carry with them less of the irrelevant detail and are more likely to suggest the essential common characteristics of things belonging to the same group. The same law of the economy of consciousness which impels to the formation of

concepts would at the same time operate to give greater abstractness to the image aspect of the concept.

(4) Meaning and thinking.

With the growth of experience, particularly with the development of the power to shape our conduct with reference to more remote and more complex ends, we must often be satisfied temporarily with *merely knowing* what we can get out of a thing without actually going through any reaction process calculated to get it. It is sufficient for our needs in certain cases to know what *would* happen *if* we reacted in a certain way. This is preëminently the case in problematic situations calling for thinking.

In thinking we are, as has already been explained, concerned with mentally working something out, or experimenting in terms of the imagination, before we go through with the motor process. This we do either in order that we may better determine whether we want a certain thing to happen, to become real, or in order that we may work out the precise series of steps which will most certainly and adequately realize the end which we wish to attain. Now, for the purpose of making connections in thought, right anticipations of the outcomes of reactions, that is, right meanings, are just as adequate as the actual concrete results themselves. In fact, they are a great deal better; for we are spared the trouble of going through irrelevant motor processes, or of experimenting in terms of action in ways, which, if not successful, defeat forever the achievement of our end. The concept, as the instrument for easy manipulation of meanings, is, then, a very important factor in the thinking process.

3. The Concept as a Tool of Adjustment.

(1) The concept and reaction.

Specializations of consciousness arise in the process of adjustment as devices for the more specialized control of reaction. The concept is no exception to this rule. In

repeated experiences with the objects which the child manipulates and tries to control, he finds that objects of a certain shape roll. The meaning of rolling comes to be firmly associated with all the round objects. Here, as a result of reaction processes, the single meaning has come to be uniformly attached to a whole group of objects. They all have the same meaning; the child has the concept ball.

But would the image of roundness suggest the common meaning of rolling, if the rolling of the ball had been a matter of indifference to the child? If he had not sought to manipulate and control the ball, it would not have mattered to him whether it would roll or not. He would have had no occasion for attaching any significance of this sort to the quality of roundness. But, as the child is a creature who loves to make things move and to see them move, it is of very great significance to him to be able to anticipate from the image roundness the experience rolling. Having attached this meaning of rolling uniformly to round things, his concept ball becomes a mental tool for guiding and directing his reaction to this whole class of objects. When he sees the round thing, his play impulse is set free in a definite form; he will push or throw the object. The control of motor reaction is, indeed, the first and most primary function of the concept.

The concept represents a definite meaning, or core of meanings, which has in the first place been built up in the process of action. But this core of meaning, when once built up, functions to set free a single definite mode of reaction for a whole lot of individual things or individual situations of the same type or class. To take another illustration, when we have the concept apple, we do not need to find out and learn a different mode of reaction for every individual apple in the barrel. A single mental image, and that probably only a very schematic and quite abstract one, symbolizes an essential core of meaning which sets free one appropriate mode of reaction equally applicable to all the

individuals, namely, eating them. So with the concept pen, the concept fear, the concept money, etc., they are all tools for the simplification of reaction processes through the reduction of them to characteristic modes of procedure which may be employed repeatedly in the control of individuals of a class.

If we had to deal with all the objects and all the situations which enter into our experience, each one by itself as an absolutely independent affair, then our conquest over the world in which we live would be slow indeed. The concept simplifies our lives of action by enabling us to deal with things in groups. On the mental side of control, it has practically the same function as habit on the motor side, namely, the task of reducing to method and system our modes of dealing with things. Because the concept simplifies our mental life, in the organization and classification of our world of meanings, it also simplifies our world of action. And conversely, because we find ourselves successful in meeting our needs by certain more or less uniform modes of reaction toward all the individuals in a certain group, our concept becomes more and more fixed in its limitation to a certain core of meaning.

(2) The concept and mental construction.

The concept serves another function besides that of immediate control over action. It is also a tool of mental construction. The concept may function to suggest a *method* of construction.[1] The image may symbolize a *principle,* or *law,* of construction. In thinking, the question is not always one of motor control, but of control over the images and ideas necessary to the proper transitions of thought. The concept stands for and suggests the method, or rule, in accordance with which we can construct the requisite image out of the elements of our past experiences. We do not then have to remember all the individual past experiences in order to find that which is relevant to meet

[1] Dewey, *Psychology,* p. 205.

the needs of our present problem of thought. The significant and vital aspects of these individual experiences have been condensed at certain centers and intimately knit together and organized under a single image which is now uniformly their bearer or symbol. Thus, in the case of the concept triangle, a single image triangle is sufficient to carry in my thought the general method, or rule, in accordance with which I can construct thousands of other images corresponding to triangles which I have actually seen, or which I may produce upon paper, or which I may need merely for mental purposes. The image aspect of the concept triangle is for the mathematician merely the carrier, or symbol, of the definition or rule of construction. It means the *way*, or *method,* rather than the individual thing. The *way* triangles are constructed is general, or universal, namely, the drawing of three straight lines to inclose a rectilineal figure.

Incidentally, it may be apropos to remark here that such a view of the concept instantly solves a difficulty which many have experienced in seeing why it is that a demonstration of a proposition with a single figure is satisfactory for all triangles. If we analyze the demonstration of the theorem that the sum of the angles of a triangle is equal to two right angles, we shall quickly see that the whole proof depends on the *way in which the triangle is constructed* and that none of the elements of particularity are used in any part of the proof. Now this *way, or method, of construction* is the *same for all triangles.* Hence the proof is adequate for all triangles.

The same line of thought which we have applied to the concept triangle holds good for the scientific concept horse as contrasted with the practical. The image itself may be particular, of some particular horse of my experience, but as concept it functions to suggest the method of construction, all that would be involved in making an individual of this species, if that were in my power. Though we may

not really make an individual of this species, yet we may mentally construct one, and this is just as satisfactory for purposes of thought. The image horse functioning as concept symbolizes the rule, or method, of mental construction. A single method applies to all the individual cases of mental construction of horse, the variations are a matter of individual detail. So it is with all the concepts of descriptive and explanatory science, used in the organization and classification of knowledge. They suggest methods of mental construction as contrasted with the concepts of ordinary practical life, which are more immediate tools of action.

(3) Teleological nature of the concept as a mode of mental construction.

At first thought the two views of the concept,—the one as symbolizing and setting free a method of motor control, the other as symbolizing a method of mental construction,—would not seem to be harmonious with each other and functionally identical. But just as truly as the first is teleological the second is also. The first is immediately and directly practical, the second mediately so.

The difference in the functioning of the concept horse in the mind of the farmer and in that of the scientist is due to a difference in the type of control which each seeks. The farmer is dealing with the immediately practical problem of getting work done; the scientist with the problem of organizing and systematizing and controlling knowledge or thought. For the scientist the concept horse as a mode of mental construction meets his need; for the farmer the concept horse as symbolic of a certain kind of work done, or as suggesting a method of controlling activities, meets *his* need. In both cases the concept is a tool of the mind in the control of experiences,—in the one, it is the control of thought, or knowledge, experiences; in the other, it is the control of motor experiences.

But even in the case of the concept as a tool of the mind in the control of thought, from the biological interpretation

of thought, we should have to view this use of the concept as fundamentally conditioned by practical situations and designed ultimately to function in their more perfect control. It needs no lengthy discussion of the intimate relation between the theoretical and the practical aspects of science to make this point plain.

(4) Further definitions of the concept.

In view of the preceding discussions of the concept as symbolizing modes of reaction and as symbolizing modes of mental construction, two new ways of defining the concept suggest themselves.

a. In terms of reaction.

The concept is an image *functioning* in such a way as to suggest, direct, or control a single method of reaction which applies equally to every one of the individuals of a group or species.

b. In terms of mental construction.

The concept is an image *functioning* in such a way as to symbolize the law, principle, or method in accordance with which one would mentally construct every one of the individuals of a whole group or species.

4. Growth of the Concept.

(1) Vagueness of the child's first concepts.

As meaning depends on past experience and this is limited in the case of the child, meanings for things must begin as vague and only gradually grow more definite and precise with the growth of the child's experience. If meanings are undefined and vague, then certainly concepts are in like manner defective. If the child in his play has found something which opens and shuts and he has been told that it is a hinge, he may call all things which open and shut hinges. For example, he may call a pocket knife a hinge, or even a door a hinge, etc.

(2) General and individual notions.

a. Their functional distinction.

The question is sometimes asked whether the child's first notions are general or individual. As we cannot get into the consciousness of the child to find out, we should have to work out some functional basis of distinction before attempting to answer this question. We must ask the question, What *use* does the child make of his concepts? This use can be discovered only by the study of his reactions, that is, those reactions which are evidently not mechanical, but due to some conscious process.

If the child's reaction to some individual object is special, then it is evident that to this extent his notion is individual, and this too without regard to the question of whether he is right or wrong. The problem is one of *his* consciousness, not ours. A wrong concept is psychologically just as truly a concept as a right one. If his reaction to a whole group of objects, whether from our point of view rightly or wrongly, is the same for all the individuals in the group, it is evident that in that degree his concept is general. Thus the child may persistently react to only one object as spoon. If so, it is evident that the meaning of something to assist him in eating attaches to this one object, and hence his notion spoon is individual. On the other hand, he may be equally satisfied with any table utensil to perform this function and be satisfied with the name spoon for any one of them. In this case his notion spoon is psychologically a true general notion, even though too general to be true logically. But either the generality or the individuality of the child's mode of reaction may be due to the indefiniteness and vagueness of his notion rather than to any positive body of meaning.

b. The question of their genetic order of precedence.

The traditional view is that individual notions precede general notions. Observation of children from the point of view indicated, however, seems to show that they do

have vague general notions very early, if not from the very beginning of conscious experience. But these vague general notions are apt to be negatively rather than positively general.[1] It is an inherent and original characteristic of mind when confronted with a situation demanding reaction to adapt the reaction to the individual character of the situation. It is equally just as fundamental and original a tendency of the mind (and this is evidenced by the law of apperception) to apply a mode of reaction once effected or a meaning once attained to a new situation or a new object *which has not yet been discriminated as different.* That is, the tendency to generalize is fundamental to mind. Which comes first in actual experience, the individualizing or the generalizing tendency, is a function of the situation which presents itself. In any case the first notions are so vague and formless that from the adult point of view there is little point in applying to them either the term individual or the term general.

(3) Development of concepts.

We have seen that the question as to which precedes in point of time, the individual notion or the general, is more or less futile and meaningless. From the genetic and functional point of view, we are not so much concerned with the origin of concepts *de novo* as with their differentiation, growth, and development out of the dim background of a vague and undifferentiated conscious experience. Concepts of some sort originate inevitably as a matter of economy of consciousness as it functions in the reactions of the child toward things, and they get their development and sharper definition in the same process of activity as that in which *meanings* grow.

Presupposing a vague background of conscious experience, how do individual and general notions emerge differentiated from each other sufficiently to have positive rather

[1] Angell, *Psychology,* p. 261.

than negative character? Mr. Dewey[1] works out quite carefully the psychology of the process as one in which individual and general notions develop together, every modification in the one affecting the other, until finally by mutual interaction both become definite and accurate. Let us take his illustration of the development of the notion papa, working it out, however, in harmony with our discussion of reaction and meaning.

In the first place the child may react to all men in much the same way. Is this because he has a general notion man? If so, it is negatively general, general merely from the absence of discrimination of the individuals. But when he learns that he can anticipate from only one man a certain set of agreeable experiences,—such as being provided with toys, being tossed up and down and played with, riding on the shoulder, and being carried out into the garden, etc.,—then he discriminates this man from the others, he individualizes this man as his papa, and ceases to react to others in the same way as to his papa. In so far as he does this, he may be said to have an individual notion papa; but who would say that this notion has in it any of the scientific idea of paternity? Yet the child has taken an important step in the development of an individual notion. Now, in the process of his experience he sees other children get the same sort of agreeable experiences, and quite likely certain characteristic disagreeable experiences, in their relation to other men. He applies his notion papa to these men also. They are the papas of those children. Thus he generalizes his idea, or rather makes more definite his implicit general notion papa. But he has in the very process of doing this also made more definite his individual notion. These other men are papas, but they are not *his* papa. That idea is strictly applicable to only one individual. Thus he has more sharply defined *both* his individual notion and his general

[1] Dewey, *Psychology,* pp. 208-211.

notion *at the same time,* or in the same process. In this manner, by continual reconstructions within the limits of his experience, by a sort of analytic-synthetic process which goes on unreflectively, the child develops *together* his individual and his general notions.

(4) Acquisition of new concepts.

The same general principle of differentiation from a vaguer background applies here as in the case of the development of individual and general notions just discussed. Take the case of the child's acquisition of the new concept sheep. He has already had experience with the dog. The process of apperceiving the new works in terms of both analysis and synthesis.

The analysis of both dog and sheep results in noting points of identity,—same size, same general shape, four legs, tail, hairy body, etc. These are common terms of the new and the old. Through them the new is assimilated to the old, is perceived in terms of the familiar. The animal is some sort of dog. This is an act of synthesis.

But a further phase of analysis was involved in the fact that differences must have been noticed which made this process of assimilation not so easy after all and not wholly satisfactory. The new animal was discriminated from the familiar dog, it could not be wholly identified with this animal. There were differences in the hair which might make the child call the animal a curly dog, and there were differences in the characteristic cry which might have led the child to call the animal the baa-baa-dog.

This identifying of the differences analyzed out with the already recognized core of identity between the two animals is a further act of synthesis. When the child's mind has gone thus far, he has virtually acquired a new concept. Incomplete and inaccurate though it may be, it is now the concept sheep, and he needs only the name to fix it as a new concept, though of course subject to further development in the process of experience.

In this process of acquiring the concept sheep through the concept dog as an apperceiving mass, it is to be noted that the concept dog has also become more definite and precise. The concept dog can no longer include these curly, baa-ing creatures. Certain characteristics of the dog, like the nature of his hair and his characteristic cry, have ceased to have vague significance and have now come to have definite significance. Of course further experience with both dogs and sheep will probably compel the child later on to reconstruct his concept dog again with reference to the significance of woolly hair as an essential difference, and he will seize upon something else.

While we have consciously analyzed what is involved in the process by which the child might acquire the new concept sheep, the child himself would most likely be wholly unconscious of these processes that we have so definitely pointed out. The whole procedure with him would be unreflective.

(5) Change and fixity of concepts.

We are now prepared for the idea that a concept is not a fixed and unchangeable thing. The child's concepts are subject to growth and development. The same is true of those of the adult, though there is a strong tendency toward fixity of concepts with the growth of experience. As meanings are an outgrowth of experience, we can see why concepts should be subject to change with the growth of experience; and we can also see why with the repetition of experiences of the same sort in a world, or realm, of limited experience concepts should ultimately become quite fixed in character.

An analogy will help us at this point. The hammer probably originated in the choice of any stone which would serve better than the fist in breaking open or crushing food materials. Then a stone of a certain convenient size and shape was selected and kept to be used regularly for this

purpose. Later a handle was added, and thus we have a fair beginning of our hammer, which has continued to undergo changes down to the present moment to meet new conditions of work to be performed. The hammer has been subject to the *law of change* throughout the centuries *because of its functional nature.* It has had work to do, and its form has had to undergo the changes which have made it adapted to the kind of work to be done under changing industrial conditions. Now the concept, as a mental tool, if it is to perform its function, must undergo the changes which better adapt it to the work it has to do as the new demands of mental experience, particularly during the period of development, are put upon it. The hammer, also *because of its functional nature,* is subject to the *law of fixity.* Doubtless it did remain fixed in certain stages of its development for many centuries because of its satisfactory adaptation to existing conditions of a static industrial life. In like manner, any concept tends to become fixed so long as it meets adequately the needs of existing static thought situations.

Supplementary Readings for Chapters XV, XVI, and XVII

Angell, *Psychology,* Ch. 10.
O'Shea, *Education as Adjustment,* pp. 163-178, 210-214.
Stout, *Manual of Psychology,* Bk. 4, Ch. 4.

Angell and O'Shea have both given strong functional and biological statements of the concept. Stout's treatment is tinged with the functional point of view.

Dewey, *Psychology,* pp. 204-13.
Dewey, *The Child and the Curriculum,* pp. 25-40.
James, *Psychology,* Briefer Course, Ch. 14 and pp. 354-7.
Bagley, *The Educative Process,* Ch. 9.
McMurry, *Elements of General Method,* Ch. 6.
McMurry, *Method of the Recitation,* Chs. 4 and 9.

CHAPTER XVI

THE CONCEPT AS AN ELEMENT OF TECHNIQUE IN THINKING

(CONTINUED)

1. PSYCHOLOGICAL AND LOGICAL CONCEPTS.

Concepts may be distinguished on the basis of the *degree of reflection* with which they have originated. On this basis there are two classes,—the psychological and the logical types of the concept. These do not differ from each other in kind; but the logical concept represents a higher stage of development of the *reflective* element.

(1) The psychological concept.

Most of our concepts originate unreflectively. The boy in the country has quite correct practical notions of chestnut tree, walnut tree, butternut tree, and hickory tree. But his concepts of these various classes of trees did not come to him reflectively. In the process of his experience in hunting for nuts, he has had occasion to absorb a large amount of detailed fact as to the characteristic shape of the leaves and the characteristic qualities of the bark and of the general shape of each one of these kinds of nut tree. By a process of unreflective analysis running through a long period of time he has come to distinguish the different kinds of nut trees by certain characteristic external appearances, and by a process of unreflective synthesis, also running through a long period of time, he has come to associate together a certain group of qualities by which he identifies each kind of tree. He has a meaning, or core of meanings, which he attaches quite uniformly to the symbol, whether word image or concrete form image, chest-

nut tree. The same is true of every one of the other kinds of nut tree. But this meaning is not one which he has arrived at as the result of study or of reflection upon his experiences. It is a good working meaning which has arisen in the process of controlling his actions, and that is all.

The child in the country sees plants grow from spring until fall. He absorbs a large amount of quite detailed fact in the satisfaction of his natural impulse of curiosity. By a process of unreflective analysis and synthesis, he learns that the plant goes through several stages of development, sending roots downward and seed leaves upward; shooting upward with stalk, branches and leaves; putting forth bud, blossom, and seed; dying down again in the fall. Thus he arrives unreflectively at a general law, or principle, of development.

The mental life of the child and also of the adult is just full of these unreflective working notions, whether class concepts or general laws and principles, notions which have never been loosened from their setting, but which have, like Topsy, just "growed." Such notions are called psychological notions. *The psychological concept may be defined as one which has arisen unreflectively in the give-and-take of experience, and in which the elements of meaning have, consequently, not been brought fully and explicitly to consciousness.*

(2) The logical concept.

The logical concept is the result of reflective reconstruction of vaguer concepts. The scientist goes over his experiences with nut trees and also supplements them with further specific and careful observations. On the basis of this more reflective study he constructs his concepts of chestnut tree, walnut tree, etc. In these cases the concepts are so definite and so carefully limited in the mind of the person who has them that he can give definitions. But ask the average boy what a chestnut tree is, and he will tell

you simply that it is a tree that bears chestnuts. And ask him how he knows that a certain tree is a chestnut tree, and he will probably tell you that he has always known it, or that everybody knows that it is a chestnut tree. But the scientist knows exactly the meaning which is involved in the use of the term; for it has been carefully and reflectively worked out by specially directed observation and study with a view of determining the essential characteristics of the thing.

The same general principle holds true of that class of concepts which we more commonly call laws and principles. The child may in a vague way know something of the law of development of plants. But he has never worked out that law reflectively and might have great difficulty in formulating it in any satisfactory terms. But the trained botanist, having gone over the whole ground very carefully with the explicit intention of finding the exact law, would have a clear and definite idea of it which he could formulate in exact terms.

Whether we are dealing with class concepts or general notions in the form of laws and principles, it is these reflective notions which we call logical concepts. *The logical concept may be defined as one which has arisen as the result of reflective reconstruction, and one in which the elements of meaning have, consequently, been brought fully and explicitly to consciousness and have been formulated in the mind.*

2. Further Comparison of Psychological and Logical Concepts.

(1) As to accuracy.

Either type of concept may be accurate, and either may be inaccurate. The psychological concept of engine built up gradually and unreflectively in the daily experience of the engineer may be very accurate indeed; while we know that many logical concepts of science carefully and reflectively

worked out have been, from lack of adequate data, very inaccurate. But, other things being equal, we should expect the logical concept to be the more accurate, because the meanings which have become involved in it have not been left to chance experience, but observations have been carefully controlled, possibly additional experiments have been performed to supplement observation, and the concept has been worked out with conscious care and system.

(2) As to adequacy.

The simple psychological notions which most of us have of chair, horse, water, etc., may be adequate to the control of our ordinary activities. But when difficulties arise in the application of psychological concepts, then they often prove to be very inadequate. The logical concepts are more adequate for all manner of situations than the psychological concepts. This is because they have been reflectively built up and the individual knows exactly what they include and can hence control them better as tools of action or of thought. They can be wielded, as it were, with greater deftness and precision. For purposes of control there is a vast difference between *being right* and *knowing that you are right.* An important aspect of control of a situation is knowing in advance just exactly how it is going to come out. In an emergency involving a very critical surgical operation, we should certainly prefer, of two surgeons having equal motor skill, the one who had the more consciously precise and exact concepts of the anesthetics used and the more logical concepts of the organs and functions of the various parts of the body. We should expect him to exercise a greater refinement and delicacy of control than the so-called self-made surgeon.

(3) As to relative prevalence.

The child's concepts are dominantly of the psychological type. Adults use both kinds. Educated people use more logical concepts than the uneducated. Many of our concepts always remain psychological, or at least undergo very

little logical reconstruction. This is especially true in the case of hosts of familiar things. Evidence for the truth of this statement is seen in the great difficulty which we have in defining many common terms of everyday use. How many can give a logical definition of table, chair, rock, honesty, truth, religion, etc.?

3. Functional Relation between Psychological and Logical Concepts.

(1) Psychological concepts the basis of the logical.

Much current psychology makes percepts the basis of concepts, but, failing to distinguish between psychological and logical concepts, proceeds to formulate the psychology of the logical concept as if percepts were the basis of logical concepts. We have already seen that it is a fundamental and inherent tendency of mind to generalize. Given a certain amount of perceptual experience, using the term perception roughly to include all first-hand experiences with things, and the mind of the child will inevitably form some sort of working general notions as the result of its own spontaneous activities and tendencies. The mind is made that way, and nothing could prevent it from a certain amount of generalizing, in spite of insufficiency of data.

It is simply not true that the child gets only individual notions from his percepts, or concrete experiences. If he did get only a lot of isolated individual facts, which later he had to compare and from which he had to abstract common qualities as the basis of generalization, whence would arise the problems that would impel him to go through with such a process of reconstruction of experience? No, from the very start he is getting some sort of organization of his experiences; in other words, he is getting general notions. These general notions, however, are of the unreflective, or psychological, type. Unreflective notions are the first fruits of concrete experiences, and these unreflective, or psychological, concepts are the real basis of logical concepts, both individual and general.

The psychology of the logical concept must not, then, be written without explicit recognition of the fact that the mind already has unreflective notions which lie back of and condition the process of attaining logical concepts. The teaching process aims specifically at logical notions, both individual and general, but much of the method as expounded in books on pedagogy is vitiated by the fact that it is based on a psychology of the concept which recognizes no psychological concepts as intermediary between the child's percepts and his logical concepts.

(2) Conditions of the logical concept.

When in the process of experience any unreflective concept proves inadequate to the performance of its legitimate and normal function of controlling action or thought, then that concept itself becomes problematic and the subject of investigation. The *degree* in which it becomes acutely problematic will determine in large part whether the reconstruction shall be unreflective, and hence lead only to a further development of the psychological concept, or whether it shall be reflective and lead to a more logical concept.

a. Unreflective reconstruction, not leading to logical concepts.

The degree of acuteness of the problem, we have just said, is a factor in determining whether reconstruction shall be unreflective or reflective. Take, for example, once more the case of the sheep which the child first called a dog. The fact that it did not bark, but rather bleated, that it had woolly hair, that it would not come for whistling, that it was not friendly and would not come and play with the child,—any one of these may have operated as a factor of doubt. The concept dog would not work smoothly. It neither controlled adequately the thought process of naming and identifying, nor did it control the process of right reaction to the creature. But in this case the problem was probably not consciously felt as acute enough to call for

any elaborate investigation and the concept was unreflectively reconstructed. The problem was acute enough to cause wonder and surprise, but was probably solved satisfactorily for the child at that time by the father's calling the animal a sheep, and by the recognition on the part of the child of enough that was characteristic of the animal to be able roughly to identify a sheep when seen again.

When a certain little boy was about two and a half years of age, his parents moved from a flat into a house. The child was sent to a neighbor's home while the moving took place. There he went to sleep and did not awake until he had been brought into the new house and it was morning. In the morning, he ran about the house with great eagerness, noticing things. Some of the furniture had been changed about to be adapted to the new conditions of living in a house. Among other things, the old dining-room rug had been put in the mother's room and a new rug put into the dining room. The child went to his nurse and said that he wanted his breakfast, but that he wanted it in the dining room, "and the dining room is in mamma's room." Here is a good illustration of a vague psychological concept dining room. Its identifying characteristic was the rug. But it was also associated with eating. In this change of the rug to another room, while eating would henceforth be done on a different rug, we have the conditions for the reconstruction of the psychological concept in such a way as to emphasize the eating aspect rather than the rug aspect. But in this case, the reconstruction of the concept which adapted the boy to his new surroundings when it did occur was not made reflectively. The concept was only further developed and made a more accurate psychological concept, or the *degree of reflective reconstruction* was so small that we should not yet want to call the concept a logical one.

b. Reflective reconstruction, leading to logical concepts. In many cases where the concept breaks down, or fails to work as a tool of control, the problem is felt more acutely

than can be expressed in terms of mere wonder or surprise. It sets up a genuine process of reflection and investigation. And the concept is reconstructed as the result of this further intentional study. Take, for example, the chemist's logical concept of water as H_2O. Why did the concept ever take this highly logical form? In the attempt to control certain chemical processes, perhaps to make some kind of medicine, or some other useful product, he found that his ordinary concept of water as a transparent fluid of a certain density would not work; it would not control this situation. The difficulty compelled him to make a further and more elaborate investigation of water before he could proceed. As a result of his experimentation he found that for certain chemical purposes he must conceive of water as made up of two gases, hydrogen and oxygen, in a certain definite proportion as indicated by the formula H_2O. When he did so conceive of water, his difficulties in controlling his chemical experiences vanished. The concept in this case has been reflectively reconstructed and is now logical and precise.

The illustration just given suggests a truth often emphasized in our functional interpretation of psychology. The concept is evidently relevant to a need; the tool formed for the more adequate control of a certain type of experience is specialized in the form which it assumes with reference to the kind of work to be done. The chemist's logical concept water does not always take the form H_2O; sometimes it is more important that those characteristics of the fluid stand out in consciousness which make it an important solvent of certain classes of substances. Again, the physicist may have a logical concept water still different. But in every case the logical concept water has been built up reflectively to meet a need in the control of action or of thought that could not be adequately met through the more unreflective concept. Perhaps one might say that the full logical concept would represent the sum total of all the

meanings which have been found essential to the control of these various aspects of experience.

4. Process of Attaining Logical Concepts.

(1) General statement.

Logical concepts are attained through a process of reflective reconstruction of already existing concepts of the psychological type. We have seen already that psychological concepts grow up unreflectively through a sort of analytic-synthetic process of assimilation. Logical concepts are built up through the same process organized, systematized, and reflectively controlled. As has been already explained, the condition which calls for this reflective process of reconstruction is doubt of some sort occasioned by failure of the already existing concept to function adequately in the control of action or of thought.

When the psychological concept is one that is already rich in all the essential elements of meaning, the process of reconstruction called forth by a new demand, like that of being asked to give a definition, is often much like a case of sudden crystallization. When the light of reflection is turned on, it seems as if the essential elements of meaning immediately stand forth, and the transformation from psychological to logical concept is so sudden as to defy analysis. But where the process is more complex, it is customary to analyze it into a series of steps, or phases.

(2) Outline of the process.

This is usually described in the books in terms of the following series of steps: (*a*) Observation of individuals; (*b*) comparison of these individuals with reference to their likenesses and differences; (*c*) abstraction of the common qualities; (*d*) generalization, or the massing together of these abstracted common qualities into one idea equally applicable to all of the individuals.

(3) Criticism of the traditional account.

The account just given of the process of attaining con-

cepts is true only as it applies to the logical concept; while the traditional account leaves one with the impression that it is the method by which *all* concepts are attained. But, even if we take it as a fair outline of the process of attaining logical concepts, it needs more qualification and explanation than is usually given to it. It needs to be rightly interpreted in order to be true.

To suppose that the process begins with a lot of miscellaneous percepts is fallacious. Take the concept chair, for example, which the psychologist has so often used for illustrative purposes. The traditional account is somewhat as follows: We observe a lot of individual chairs; we compare them and find that each has a back, four legs, and a seat which is suitable for one person; these common characteristics we now abstract and hold before the mind, ignoring all the variations of individual from individual; then we generalize by saying that a chair is a piece of furniture having a back, four legs, and a seat suitable for one person.

Now is the process of generalizing and attaining logical concepts quite so simple as all that? We might quite naturally ask, How did it happen that all the individuals selected for observation and comparison were chairs and none of them were beds, lamps, elephants, etc.? If logical concepts are based on percepts, or individual notions, why was just this particular selection of individuals made which all fall within certain well-defined limits? The answer is quite simple. The process of working out the logical concept did not start with individual notions. The only reason we can give why the selection of individuals was so limited is that we *already knew* in some sort of fashion what a chair was, we *already had a psychological concept chair.* This psychological concept was dynamically related to, and functioning in, the whole process by which the logical concept was built up. Some failure in this unreflective concept to meet the needs of action or of thought set the problem. It furnished the occasion and motive for the

conscious and systematic investigation. But the fact that the already existing concept was inadequate might have led to the selection for investigation of individuals that properly belong under the head of stools or of benches. Nevertheless, the fact that there was a psychological concept to begin with limited to some extent the field of investigation.

We might raise the question, in like manner, why certain characteristics are singled out as essential in the process of comparison. There is absolutely nothing to determine this except that our *problem is of a certain kind* such that the selection of these characteristics is relevant to its solution. It is the problem of more accurately defining a *chair,* and we already know in some sort of a way what a chair is. This psychological concept chair dominates the process of comparison and that of abstraction. All the time that we are comparing we are looking for common characteristics to abstract which are relevant to the solution of the problem set by the inadequacy of the unreflective concept chair.

In the psychological concept we have a common core of meaning, which, though of course vague and subject to reconstruction, yet furnishes the dominant point of view for the whole investigation. It serves as the center, or rallying point, around which all the mental activities gather. It was the failure of the psychological concept that created the problem in the first place, and the common core of meaning involved in that concept gives a definite set to the problem in a certain direction, guiding and controlling the mental activities throughout and determining the order and dynamic relation of the steps of comparison, abstraction, and generalization. All these points will come out more clearly in our restatement of the whole process, which will be taken up later in Chapter XIX under the head of inductive method.

In summing up this general criticism of the traditional psychology of the logical concept, we may say that neglect

to recognize the part that the psychological concept plays in the whole process of acquiring logical concepts is vicious in either or both of two ways:

a. It leads one to suppose that he is getting a complete psychology of the concept when a very vital part, that of the psychological concept, is left out. As a psychology of the concept it would be, if not false, at least very misleading. Psychological and logical concepts need to be distinguished and their functional relation to each other clearly kept in mind. Particularly is it necessary to recognize that logical concepts rest back upon psychological concepts and these in turn are an unreflective outgrowth of perceptual experiences, and it must not be supposed that logical concepts are derived directly from a comparison of scattered, isolated, and independent individual notions, without any previous generalization having taken place. Whole sections of pedagogical works are vitiated by being based upon this handy but misleading psychology of the concept, which has its origin in the analysis of the finished products of mental action.

b. It gives one no basis for understanding the real nature and dynamic connection of the series of steps involved in the process which we have outlined as that by which logical concepts are attained. These steps become purely formal. But when we presuppose that the process has its origin in the breakdown of some psychological concept, which sets a definite problem, then the steps of further observation, of comparison, abstraction, and generalization become vital and dynamic, and their relation to one another is that of organic and necessary connection as phases within one continuous process directed steadily toward the solution of a definite problem.

5. The Logical Concept not Final.

The logical concept, once constructed, becomes a tool of the mind used freely and flexibly and without hesitation, until perchance doubt is thrown upon it again by reason of some failure to meet our needs in the control of action or of thought, when it is again subject to investigation and reconstruction. Thus a logical concept at any given time or point in our experience is not necessarily final. In certain phases of our experience, particularly the mathematical, logical concepts once attained are apt to become fixed. It may be instructive to point out that even in this sphere there are logical concepts that have to be reconstructed.

The logical concept of exponent attained in the study of arithmetic is adequate to the needs of that subject. There we think of an exponent as a small figure placed to the right and a little above a number to indicate how many times it is taken as a factor. But in algebraic problems there arise situations to which we apply the laws of exponents which satisfied us for arithmetic and we get into trouble with our concept of exponent. Take the following simple cases:

$$\frac{a^6}{a^3} = a^3, \quad \frac{a^6}{{}^6} = a^2, \quad \frac{a^6}{a^5} = a^1, \text{ or } a.$$

Here the law of exponents demands that in the process of division the exponent of the divisor be subtracted from that of the dividend to determine the exponent of the quotient. The quotient is one that can be easily interpreted under the prevailing concept of an exponent as indicating how many times a quantity is to be used as a factor. But let us go right on consistently applying our law of exponents to the following cases:

$$\frac{a^6}{a^6} = a^0, \quad \frac{a^6}{a^7} = a^{-1}, \quad \frac{a^6}{a^8} = a^{-2}, \text{ etc.}$$

Now apply the concept of exponent to the resulting quotients. Is it intelligible to say that a is to be used zero

times as a factor, or that a is to be used -1 or -2 times as a factor? Our concept of exponent breaks down at this point. We must either refuse to apply any further the law of exponents applicable to division and say that it is not a universal law, or we must reconstruct our concept of exponent. We do the latter and admit zero and negative exponents, giving them an interpretation in harmony with the facts as seen from another principle of division. Because $\frac{a^6}{a^6} = 1$, according to this other principle of division, we say that a^0 must equal 1; and because $\frac{a^6}{a^8} = \frac{1}{a^2}$, according to this other law of division, we say that a^{-2} must equal $\frac{1}{a^2}$. Thus we reinterpret and reconstruct our concept of exponent to make it harmonize with a new set of facts, to make it a tool which we may employ to control new situations more adequately than they could otherwise be controlled. Mathematics furnishes illustration after illustration of this breaking down of concepts which are adequate at one level and their reconstruction to make them adequate at another and higher level in the attainment of control.

The progress of all our sciences has involved the reconstruction of many logical concepts. What a tremendous reconstruction of logical concepts in every department of human thought has been provoked by the application of the idea of evolution! This lack of finality to our logical concepts need not worry us in the least, if we look upon them from the functional point of view as tools of the mind for controlling thought, and through thought ultimately action. Why should it not be a source of satisfaction that humanity may improve the tools of thought as well as the tools of commerce and industry? In fact, one might say that the only way that we can improve the tools of

commerce, of industry, of practical benevolence, of religion, and in general of everything on which the progress of humanity depends, is by improving the tools of thought.

6. Significance and Function of the Concept in the Thinking Process.

The concept is the most important element of technique in thinking. It is the great simplifier of mental processes. Just as habit reduces the multiplicity of muscular movements to a few simple methods of reaction that can be used for a variety of like situations, so the concept reduces to methods that apply to a large number of individual cases the interpretative and guiding function of consciousness. A concept is a sort of mental habit. This is of great significance for the process of thinking. Concepts furnish certain organized centers for the control of the thinking process. The concept is, as it were, the pivot on which the whole thinking process turns. The pivotal character of the concept may be worked out in two directions.

(1) The concept central between individuals which are problematic and individuals brought under control.

In thinking, we are either analyzing and comparing individuals as a phase of the process of perfecting some concept, either reflectively or unreflectively; or we are taking concepts for granted and are using them to interpret and control individuals. The concept thus occupies a central position between individuals which are problematic, and hence cannot be controlled adequately, and individuals which are properly interpreted and hence can be controlled. This thought is sometimes expressed by saying that in thinking we proceed from individuals to individuals by way of the concept. In actual life it is always individual things or situations which we have to control. The problem is always particular. The concept is not, then, the ultimate goal of thinking; it is rather the tool of thinking in dealing with individuals.

The thought just developed can be clarified by the analogy of a machine, say the reaper. In harvesting grain the problem is always one of controlling some particular situation, of reaping some particular field. There is in human experience no such thing as harvesting in general. Yet, *it is just as truly a part of the harvesting function to perfect the reaper as to use it.* We perfect the reaper, however, not for its own sake; it is not ultimate, the goal. It is only an instrument for the more adequate control of the individual harvesting situation. *But this machine, when it is perfected, has this great significance, that its method of operation is general,* and hence this same machine can be used to control other individual harvesting situations, to reap other fields of grain or to reap the same field another year. The movement has been from individual harvesting situations which were problematic to machine and from machine to the control of individual harvesting situations. Now, just as the reaper arises out of the need of individual situations and, when perfected, functions in the more adequate control of those individual situations, so it is with the concept.

The analogy holds true at another point also. The machine is not fixed, but it is subject to modification at such points as inadequacy may be discovered in actual use. So it is with the concept. The concept, then, is to be viewed as a tool of thinking, and its central position in the thinking process is due to the fact that thinking, like industry, is either moving in the direction of perfecting its tools or in that of making use of them.

(2) Another way of expressing the idea that the concept is pivotal in the thinking process.

The concept represents a certain core of meaning, and that core of meaning, if thought of from different points of view, may be analyzed into the various elements which are bound together in the complex. For example, take the case of orange. If the child is hungry, one meaning in the com-

plex stands out prominently,—the orange is something to eat. If the child is in a playful mood, another element of meaning relevant to that situation stands out,—the orange is something to roll. In the process of experience many meanings get firmly associated together into one system, or concept. Within this system, any one meaning may quickly and more or less automatically suggest others along the line of relevancy to our problem. When, in thinking, a concept is brought before the mind, thought moves rapidly through the complex of meanings bound together in the concept until it comes to the one that is relevant to, or suggestive of, the proper reaction or the proper connection of thought. The vital work is all done at one little center, namely, the concept. The gain in efficiency is analogous to that which Ericsson introduced into naval warfare by mounting guns on a revolving turret so that they could swing easily and rapidly about and be fired in any direction without having to turn the whole vessel around.

(3) The increased efficiency of the logical concept.

It has already been pointed out that the logical concept is superior to the psychological as a tool of thought on account of the fact that the meanings have been made explicit through reflection and are thus more available for rapid and accurate transitions of thought. This point ought to be more clearly seen in the light of the preceding discussion.

In time of emergency it is not only well to *have* the appropriate tool to use, but also to *know exactly where it is* and to be able to lay hands on it at once. A carpenter may have all the tools that are necessary to do a certain piece of work, but it makes a vast difference to his efficiency whether his hammer is in the barn, his chisel in the attic, his plane in the tool shed, his ax out in the woods, etc., and he has to hunt them up when he wants them; or whether each is in the proper place in a compact tool chest or cabinet. In one's stock of psychological concepts, he may actually have the meanings that are necessary to carry through success-

fully a line of thought which shall solve his problem; but those meanings are much more available for use and tremendously increase efficiency if they are all closely knit together in a logical concept and he is conscious of the exact place and significance of each one of them.

Logical concepts resulting from a vital thinking process and representing an actual organization of meanings for one's self cannot fail to increase the flexibility, freedom, and reach of one's thinking power in any field in which they are relevant. It becomes, then, a very important matter educationally both that children acquire logical concepts and that they acquire them in such a way that they become dynamic elements in thinking rather than empty or vague symbols merely. The next chapter will discuss in more detail some of the educational principles which follow from our psychology of the concept.

CHAPTER XVII

THE CONCEPT AND INSTRUCTION

1. The Concept is not the Goal of Instruction, it is to be acquired for Use.

(1) The concept a tool, not an end.

It is sometimes said that the concept is the goal of instruction. Is this view justified by the psychology of the concept just worked out? Concepts are necessary elements of technique in the thinking process. If the child is to be skilful in thinking, it is evident that instruction must concern itself with the task of building up a rich supply of concepts, and the process must be carried on until logical concepts are attained. But from the point of view of the thinking process, the logical concept, in the development of which so much thinking must be done, is not itself the goal. It is developed for the sake of use in solving further problems or in the control of action more efficiently. Only from the point of view that education is concerned with the task of supplying the child with a stock of tools, which, at a later time, when he goes out into life, he is going to use, could the concept be viewed as the goal of instruction.

(2) Concepts to be acquired for use.

A better view of the function of education insists that the child must not only be supplied with a stock of tools, but that he must also be trained to an appreciation and understanding of their use and that he must have some practice in applying them. Application of the concept is as important a phase of instruction as acquisition. No father would think that he had done his duty by a son whom he expected to train up as a carpenter when he had put into his hands a complete outfit of tools and had explained their precise

nature. The boy would have to have some practice in their use also. So it is with the concepts of the various school subjects. They are only tools of thought or of action, and instruction must concern itself not alone with their acquisition but also with practice in their application. Modern psychology would teach that even if acquisition of these concepts were the sole aim, yet this acquisition could not be made perfect except through use.

2. Concepts cannot be given to the Child ready made.

Our whole discussion of the concept has tended to emphasize the fact that concepts grow from a vague background of experience into more and more definite form as the result of a process of reconstruction. This process of reconstruction is itself conditioned, being initiated by some feeling of need engendered through the inadequacy of existing concepts. There is then no royal road of imparting concepts by short-cut methods that is in harmony with the normal processes of growth. Concepts cannot be handed out as ready-made, finished products by the teacher and appropriated by the child. They do not thus become *his* concepts. He must go through the process of getting vague ideas first and having these vague ideas repeatedly reconstructed.

This reconstruction becomes dynamic and real only when it is motivated by some feeling of need on his part. Teaching is as much concerned with the development of new needs on the part of the child as it is with the imparting of the facts. The process of reconstructing concepts cannot go on in a vital fashion any faster than it is made necessary by the development of new needs which make reconstructions of experience necessary. This development of new needs is in part dependent upon the natural development of the child and in part upon skilful instruction with that end definitely in view. Any process of instruction that does undertake to impart to the child ready-made concepts only builds up the habit on the part of the child of juggling with

symbols, concerning which reference has already been made.

3. Instruction which aims at the Development of Concepts must culminate in Logical Concepts.

We have seen that thinking is most adequate when it goes on in terms of logical concepts. That aspect of instruction which concerns itself with the perfection of the tools of thinking must not, then, stop short of the attainment of logical concepts. It is essential that the child be confronted with situations which make the reflective reconstruction of his concepts necessary. One of the chief merits of Socrates' method was that he made the subjects of his questioning keenly feel the inadequacy of their own ideas. At the same time they got suggestions as to the lines along which their concepts needed reconstruction, and they became receptive to any ideas which might aid them in the solution of their problem.

Not only to know, but also to know that you know gives vigor and incisiveness to thinking. There is tremendous added power coming from the use of the best tools. Our age differs from the stone age in large part by virtue of the fact that we have superior tools in every department of life's activities. In perfecting the thought process of the child we must not stop short of giving him the most powerful tools,—logical concepts.

4. The School must concern itself with the Problem of building up a Rich Background of Psychological Concepts in the Mind of the Child.

(1) Argument from their basic character.

As psychological concepts are the matrix out of which logical concepts will come as the result of reflection and further observation, and as breakdowns in these concepts are going to furnish the problems determinative of the course of reconstruction, it is important that the child have a rich supply of concepts which spring quite directly out of his own experiences. This supply of psychological con-

cepts furnishes both material and motivation for the reconstuctions which shall yield more logical notions.

(2) The doctrine exemplified in school practice.

The modern school does much to enrich the stock of psychological notions which the child brings to bear upon the more formal aspects of school study. Excursions to fields and parks to see plants, animals, and natural phenomena give the child material from which his little mind at once acquires notions both individual and general. Constructive work of various kinds furnishes still another source for such notions. The child's language notions are developed unreflectively through stories and oral reproduction and simple composition long before he studies grammar, which reconstructs these notions reflectively and makes them logical.

There is a very strong tendency at the present time in the direction of making the work of the first three grades less formal and less specialized, making it, in other words, preëminently the work of building up the background of first-hand experiences with the things which will be more systematically studied later on in the higher grades. Experiences with number, language, geography, and nature in the concrete first, technique later on, that is the watchword. Let the child drink in, under guidance and direction of the teacher, an abundance of concrete impressions, forming his own ideas, and later on concern ourselves with the task of more explicitly working them over into a more logical form. The child who comes to the study of chemistry and physics with a mind full of ideas of his own derived from first-hand experiences in domestic science and manual training is in a position to appreciate quickly the problems of the new sciences and to reconstruct his concepts in harmony with the demands of those problems.

(3) The doctrine applied to religious instruction.

There can be no better preparation for the more precise formulations of religious truths than perfect familiarity

with the concrete story material of the Old and New Testaments. Religious teachers are apt to be in too big a hurry to indoctrinate the child in the great fundamental tenets of their faith. These logical concepts are too frequently empty forms both for children and for adults of that class who are still children in type of thought. More work with concrete material calculated to build up psychological notions, while making haste more slowly, would in the long run lead to clearer-cut logical notions through having supplied sufficient basis for the process of reconstruction without which the logical notions are felt to be irrelevant and meaningless. The doctrine "from the concrete to the abstract," or better, from the psychological to the logical, if applied to the work of the Sunday School, would quickly do away with a uniform course of study for all ages from the kindergarten child to the adult of the Bible class.

(4) The doctrine applied to moral instruction.

The public school is frequently criticized of late for its failure to teach morals. Every good teacher of right ideals and habits is doing more teaching of morals in the lower grades at the present time than if a text-book were employed for the purpose. Children are taught morals in their concrete relations with one another and with their teacher all day long in the classroom. Every good teacher is constantly insisting upon right conduct and good manners. Truthfulness, kindness, cleanliness, promptness, willing obedience, regard for the rights of others, etc., are being learned in the concrete. Children's ideas are being formed along these lines unreflectively. Probably the school ought, in harmony with the idea of passing on from the psychological notion to the logical, at some point in the higher grades to begin to make the principles of morals stand out more reflectively. They ought to be brought more definitely to consciousness. But no amount of teaching morals in terms of the logical concepts can ever take the place of the work done at the present time in the lower

grades along the line of indirect teaching of morals, nor can it be done at this age so effectively in any other way.

5. The Test of whether a Child has a Concept or not is that of Function.

The concept, whether psychological or logical, is normally a tool in the service of action or of thought. Does the child have a particular concept? We often think we can tell by asking him if he understands. But telling or failing to tell is not a decisive test. Application of some sort is better. It is only a half truth, that favorite dictum of teachers: "If you know, you can tell it." If we have logical notions of things, we can of course tell what we know; but if we have psychological notions, perhaps we cannot. Yet we may in the latter case know sufficiently well for use at the present time and under the present conditions. The child's notions are dominantly psychological. Telling is consequently no adequate test of his understanding.

Furthermore, the child may be at such a stage of development or at such an early stage of advancement in a given subject that he cannot have logical notions anyway. Over-refinement in the matter of exact description or exact definition is a failing characteristic of teachers who do not understand the mental processes of children, and also of many teachers in the first few weeks of a subject perfectly familiar to them but very strange and unfamiliar to the class. This over-refinement, instead of being conducive to clear thinking, may have in the long run just the opposite effect.

6. Problems of Action are very Significant in the Process of Training to Think.

The concept, we have emphasized, is a tool of action, as well as of thought. Even psychological concepts are used to control motor processes. In fact, they originate in the attempt to simplify the control of actions by applying to whole groups of situations the same meanings, which demand for their realization the same method of reaction. As

that aspect of the concept which makes of it a tool for the control of action is the first to develop and the more reflective is the later, training in thinking should supply facilities for the use of the concept in dealing with the problems of action before the child is called upon to deal with more abstract and theoretic problems.

This doctrine would give manual training a fundamental and inner position in the curriculum instead of making it something tacked on from the outside as an extra or as a fad. Its position would be inner also in another respect, namely, that it would be thought of not merely in terms of a subject adapted to give motor skill, but as a subject demanded by the nature of the child to give appropriate first expression to his thought processes, and to supply the basis for the higher and more reflective processes involved in more specialized study.

CHAPTER XVIII

INDUCTION AND DEDUCTION VIEWED AS TECHNIQUE OF THINKING

1. Purpose of this Chapter.

It is the purpose of this chapter and of the following two chapters to give the psychology of induction and deduction rather than the logic. No attempt will be made to give an exhaustive treatment of the subject. For more detailed accounts of the inductive and deductive processes, the reader should consult some standard text in logic. There is no occasion for repeating here the admirable work which the logicians have done in the matter of analysis and description of these characteristic phases of the thinking process. We are concerned primarily with the problem of giving them a functional interpretation, with getting at them from their dynamic psychological side rather than the purely structural side. We shall view them as special organizations of the thinking process for the more perfect performance of its function. From this point of view, they are elaborate specializations in the technique of the thinking process.

2. Relation of Induction and Deduction to Each Other.

The thinking process is functionally a unity falling within two limits,—one the conceiving of an end, the other the realization in thought of that end through the perfection in imagination of the proper method of procedure to attain it. But this whole process is greatly facilitated by the perfection and use of the logical concept as a tool. And by logical concept we shall mean to include here every sort of reflective general notion, whether class concept, principle, or law.

Now, *this process of perfecting the tools of thought is not functionally separate from thinking any more than the process of inventing and making reaping machinery is separate from the function of harvesting grain;* but it falls within the process somewhere between the two limits already stated. When the movement of thought is in the direction of *perfecting its tools,* this phase of the thinking process is called *induction;* when it is concerned primarily with the *use of its tools,* this phase is called *deduction.*

Both the inductive and the deductive phases are essential and are functionally related within the complete movement of the thinking process, though they may be for some particular interval of time separated, attention falling dominantly on one phase or the other according to need. Again apply the analogy of harvesting grain. Both the invention of the tools and their use are essential to the complete and adequate harvesting function. But the two phases may be separated by intervals of time. There may even be division of labor in the performance of the complete function, one man inventing and perfecting tools while another applies those tools to the control of action. It is to be noted, however, that the invention of tools for harvesting cannot be carried on apart from the problem of harvesting, nor is their invention complete without any test of their use and their actual fitness to perform the function. The same is true of the inductive process in thinking. The complete working out of the tools of thinking cannot be absolutely separated from their use. From this point of view the complete inductive process involves deduction as the phase of testing.

3. Definitions.

(1) Their statement.

In harmony with the point of view just developed, we may define deduction and induction in functional terms somewhat as follows:

a. Deduction is that form of thinking in which an individual which is problematic is interpreted and controlled by referring it to some concept, or law, which is, for the time being at least, unquestioned.

b. Induction is that form of thinking in which a concept or law, which has become problematic, is reconstructed through an investigation and analysis of individuals.

(2) Illustrations.

a. Deduction

I find a lump of something hard and rough and glittering. What is it? The individual is problematic. I don't know what it is; shall I throw it away or put it in my pocket and carry it home? I cannot tell unless I can properly interpret it. I try to apply some familiar concept. Perhaps it is gold ore. I observe the individual to see if it has the characteristic marks of gold ore. No. Perhaps it is the presence of mica that makes it glitter. I look for the characteristic marks of mica. Yes, it is mica. The application of this concept has interpreted the individual. It is no longer problematic for thought. Consequently it is no longer problematic for action. I know exactly what to do; I throw it away. This is a case of deductive thinking. The concepts that I used were all unquestioned as to their import; the problem was in the individual. When I applied the right concept the individual ceased to be problematic. The concept mica interpreted it. It brought meaning from itself over into the little piece of rock. There was no question of what gold is or of what mica is, the question was wholly, "What is this individual thing?" And that question was settled by the application of an accepted concept.

In grammar, I have the sentence: "Hamilton smote the rock of our national resources, and abundant streams of revenue gushed forth." I ask the question, "What part of speech is streams?" Answer: "It is a noun." "Why?" "Because it is the name of something." "What part of

speech is smote?" "A verb." "Why?" "Because it asserts action." Here again we have problematic individuals, the words streams and smote, interpreted through the application of the concepts noun and verb regarding which there is no question as to their meaning. This is a deductive movement of thought.

Sometimes the deductive movement is a case of the unfolding or development of the general notion to see its application. But even in this case the individual to which the concept is sought to be applied is, when selected, momentarily problematic until the application is made. General notion: Every adult male citizen has a right to vote. Application:—John Smith has a right to vote. But has John Smith a right to vote? Does he fulfil the conditions? Is he an adult? Is he a citizen? The individual is problematic. We cannot say he has a right to vote until we have settled these two problems. Then the deduction will be evident. Since John Smith is an adult male, and since he is a citizen, he has the right to vote. We have now settled the problem whether John Smith is a voter by applying the general law.

b. Induction.

Let us now take a case of induction, such a one as might occur in actual life, not a formal case set for induction. I am a young person, brought up in a limited environment. I go to the city and meet many people. I meet Dr. Harvey. Trying to put myself at ease with him I begin to talk about things pertaining to the medical profession. He replies, "Oh, I am not a physician." I am too embarrassed to talk further. Later, I learn that Dr. Harvey is a school teacher. Well, why do they call him "Doctor"? I always thought that a doctor was a physician. My trouble is still further aggravated by discovering that Dr. Stark is a minister, and that Dr. White is a scientist. By this time I begin to wonder what Doctor means anyway. My concept proves inadequate. It does not meet the demands of the situation.

I have no way of finding out directly the meaning of doctor by going to a dictionary or cyclopedia. I begin to find out all I can about each of the men whom I meet, or about whom I may read, who are called "Doctor." I find one by one that in each case the title originated in some degree conferred by a university upon the completion of a special course of study and research. I reconstruct my concept doctor in harmony with the result of my investigation. It now has in it as the dominant meaning that of special learning along some line, whether medicine, history, law, theology, or some particular science, and the recognition of that special learning by some university. My concept doctor has been reconstructed through an investigation and analysis of individuals. The motive to reconstruction was the failure of my concept doctor to meet the needs of the situation, which threw doubt upon its validity.

As we illustrated a deductive process from grammar, so also by way of comparison it might be well to illustrate an inductive mode of procedure in the same subject. Let us suppose that it is the case of developing the idea of pronoun. We can take a series of sentences in which pronouns occur. Start with one of the individuals. Let the child tell what the word means, let him find some word which means the same and could be used in its place. This one experience will possibly give him a vague idea that there are words which can be used for other words. Take another individual pronoun. Let him tell what word this one means. And so on. Let him examine the various words for which these individuals stand. In each case, it will be brought out that they are nouns. The idea is developed that we often use other words in place of repeating nouns. He now has the concept pronoun, and all he needs is the definition to fix it in mind. In this case a vague idea is first attained, and then it is reconstructed through an investigation of more individuals.

4. The Critical Point of Distinction between Deduction and Induction.

(1) Criticism of the formula, "Deduction is a process of going from the general to particulars."

This well-worn formula is true in only a limited sense. It is one of those half truths which originate in the attempt to formulate the thinking process in terms of the results of an analysis of the finished product. The chief merit of the formula is its simplicity, but at the same time it is very misleading, without further qualification and interpretation.

We have seen in our illustration of the little piece of rock and in the illustration from grammar that deduction may psychologically start with a problematic individual, and the process may consist largely in the search for an accepted general notion capable of interpeting this individual. The general notion is not *given* to start with. From this point of view, the deductive movement consists in going from the individual to the general, the very opposite of what the customary formula has it. Certainly the selection of the proper general notion mica is a very vital part of the thinking process involved in interpreting the little piece of rock. Indeed, it is the dynamic aspect of that process. It is where the whole struggle and tension of mind centers. After the appropriate general notion mica has been selected, then, to be sure, it is applied to the individual; meaning is brought over from the general notion into the individual and that individual ceases to be problematic. This aspect of the deductive thinking process, which really represents the formulation of the finished product, may be described as proceeding from the general to the particular. But it is after all only the formal part of a thinking process the vital part of which is already complete.

The point which should stand out clearly now is that we do not necessarily, or even frequently, in deduction start out with a general notion which is *given,* from which point

on the process is merely the application of that general notion. But the *active search for* the appropriate general notion is a very vital part of the whole process. The significant point in deduction is that, whether it starts with general notions or whether the general notions have to be searched out, in any case it works with general notions which are *accepted* or *unquestioned.* The problem is not one of perfecting the tools of thinking, but of *using* those we already have.

(2) Criticism of the formula, "Induction is a process of going from particulars to the general."

The inductive process does not necessarily start, as the catch-phrase would suggest, with a group of *given* particulars, or individuals. These particulars may have to be sought after very diligently. Psychologically, the process of induction normally starts with something problematic in a concept or law. This general notion had been hitherto taken for granted, it was adequate within the limits of its previous applications. But now it fails at some point, it is unsatisfactory and calls for further investigation. Take for example the Ptolemaic system. For centuries it seemed adequate to the explanation and interpretation of the phenomena of the heavenly bodies. Even eclipses could be accurately predicted on its basis. But, later, facts were discovered which this theory could not adequately control. Doubt was thrown upon its validity. This resulted in further investigations of the phenomena of the heavens with this particular point in view. These investigations ultimately culminated in a reconstruction of the concept of the universe. The Copernican system was not entirely new; it retained much that was characteristic of the older system, but reconstructed it at critical points, noticeably in the position which the sun occupies in the system.

When a concept becomes problematic, we turn to the investigation of the individuals which fall, or might possibly fall, under this concept. This phase of the inductive

process might be described as virtually proceeding from the general to the particulars,—just the reverse of what the popular formula has it. But the study of the individuals is taken up for the sake of arriving at a more adequate concept. This phase of the process is virtually proceeding in harmony with the popular formula, "from individuals to the general." But the tension of mind due to the breaking down, or failure, of the general notion and the active search for, and selection of, the proper individuals for investigation, is a very vital part of the whole inductive thinking process. This dynamic aspect should not be ignored in a complete psychology of induction.

The emphatic point of this discussion is that induction does not start out with individuals, or particulars, which are *given,* but the critical thing in the whole process is a general notion which is *problematic* and calls for reconstruction through the search for, and investigation of, individuals which are not problematic.

(3) Deduction and induction to be distinguished in terms of locus of problem.

In defining deduction and induction we cannot seize upon the movement from general to particular or from particulars to general as the most significant thing. From the functional point of view, it is more significant to get the exact *locus of the problem.* The deductive movement starts with a problematic individual; the inductive with a problematic concept or law. The deductive movement is concerned with finding and applying the proper accepted concept to interpret the individual and bring it under control; the inductive movement is concerned with the perfecting of the problematic concept so that it shall adequately control indisputable particulars.

If we once get the locus of the problem as our starting point, the form of the movement of thought is secondary and dependent. There will, of course, be a characteristic difference in the *form* of the movement of thought in deduc-

tion and induction because the locus of the problem is different. But we should distinguish, as our definitions attempt to do, between the two phases of thinking not by the secondary difference in form, but by the primary difference in function.

5. Thinking in its Relation to System of Knowledge.

(1) General statement.

Thinking presupposes some sort of a system of knowledge. Thinking must make use of past experience as well as present, but this past experience cannot be said to have mental existence in the form of isolated chunks. There is always some degree of organization or unity or wholeness to our past experiences. They have some sort of a setting, or context; they represent systems, rather than isolated facts.

It is a commonplace of modern psychology that consciousness always gives some sort of vague *wholes* from the very beginning. To the unreflective activities of apperception and crude imagination we must ascribe the first vague unities, or systems, of knowledge which rise above the purely perceptual level. As we have seen in our earlier discussions, the child's imagination in the period from two and one-half years of age until six or seven is very active and is an important factor in enlarging and giving something of definite form to his experiences. His imagination is a solvent for the holding together in larger wholes, at least in terms of emotional congruency and satisfaction, elements that would otherwise seem discordant. We have seen that the child's experiences tend continually in an unreflective way to develop meanings, and these meanings tend to crystallize about certain symbols, and thus knowledge gets some sort of organization in the form of class concepts, laws, and principles.

Now the point of this discussion is this, that wherever you may conceive that the thinking process starts in the life of the child, there will always be some sort of a system, or

better, systems of knowledge, within which it works. The thinking process may operate within existing organizations, or systems, of knowledge, utilizing accepted ideas as the basis of adjusting means to ends; or, finding an existing organization of experience inadequate to perform the function of controlling action, the thinking process may be concerned with its reconstruction and perfection as a tool of thought. But in either case, whether the movement of thought be deductive or inductive, the starting point is within some system of knowledge.

(2) Relation of deduction to the system.

Deduction presupposes some system of *already organized* knowledge, which is, for the time being at least, unquestioned. The mind already has a stock of general notions,—concepts, definitions, laws, and principles,—which are relevant to the problem of thought. The individual which is problematic is conceived of as belonging to some particular system, only we do not know at once just how or where. But, as the system is already organized, every part of it has relation to every other part. It is possible, then, to start at any point in the system and to pass through the whole system to any other point by making *explicit* the series of relationships, or ties of connection, involved. Deduction makes explicit, by a process of analysis, the relation between the problematic individual and other individuals within the same system, and by an act of synthesis this individual is given its place within that system of relationships. When the place of the individual is definitely recognized, or made explicit, and its function within that system is seen, then the deductive movement is complete, and the individual is interpreted and brought under control.

In saying that deductive thinking presupposes a system of already organized knowledge which is brought to bear upon the individual to interpret and control it, it is not to be implied that in bringing this individual under the prevailing general notion the system is in no way modi-

fied. In deduction, however, the system of already organized knowledge, in the form of concepts, laws, etc., is the *dominating,* or *controlling* factor. But every general notion is modified in some respect by bringing under it a new individual.

(3) Relation of induction to the system.

Induction presupposes not necessarily the absence of an organized system of knowledge but merely some inadequacy in that system to control certain individuals. Take for illustration the case already cited of Ptolemaic astronomy. Induction operates within a system, but that system is one which *is being organized* or reconstructed. Its function is to so reconstruct and reorganize a system of relationships that as the outcome the general notion which results shall be adequate to the control of the individuals concerned. But there must be some system of knowledge relevant to the process to give some definite point of view for the process of investigation and reconstruction.

Supplementary Readings for Chapters XVIII, XIX and XX

Angell, *Psychology,* pp. 279-89.
Dewey, *Psychology,* pp. 220-34.
James, *Psychology,* Ch. 22.
Welton, *Logical Bases of Education,* pp. 116-22 and Chs. 9, 10, 13.
Bagley, *The Educative Process,* Chs. 19 and 20.
McMurry, *Elements of General Method,* Ch. 5.
McMurry, *Method of the Recitation,* Chs. 8 and 9.

CHAPTER XIX

INDUCTION AND DEDUCTION VIEWED AS TECHNIQUE OF THINKING
(Continued)

1. Unreflective Induction.

The process of building up concepts,—whether class concepts, laws, or principles,—may go on unreflectively. There may be no attempt on the part of the individual to control the inductive movement which results in better tools of thought. This has already been illustrated in the case of the child that had the concept dog and acquired the concept sheep, in that of the child who got a new concept dining room in which the idea of rug was not essential, in that of the boys who had good working notions of various classes of nut trees, and in that of the child who had acquired a notion of the law of plant growth. Our minds are just full of such psychological general notions, which are the result of unreflective inductive processes. Repeated reconstructions of these concepts from their vaguer to their more adequate form have taken place through implicit processes of induction rather than through any explicit mode of procedure The inductive process has gone on in terms of the assimilative activities involved in the more fundamental metal tendencies of attention, association, and imagination. The *method* of procedure is unreflective, it has not been brought definitely and explicitly to consciousness.

2. Reflective Induction.

Inductive method is not a pure invention of the scientist or of the logician. It merely makes explicit that which is implicit in the process of generalization wherever it occurs. In the reflective reconstruction of our concepts

this process becomes definite and distinct enough for us to analyze it. When we analyze the inductive process we find that it is possessed of certain well-defined characteristics, or phases. These are observation of individuals, or of particular instances, from the point of view of some problem; comparison for the sake of finding essential characteristics relevant to the solution of the problem; abstraction of the common characteristics judged to be essential; and generalization, or the setting up of the common core of abstracted characteristics as a standard by which to judge or interpret all the individuals of a class, or as a rule which applies to all cases of a certain type. When these phases of the inductive movement of thought are explicitly recognized and are organized into a definite mode of procedure which we purposely employ in the reconstruction of general notions, then induction is of the reflective type.

In an earlier chapter we gave a criticism of the ordinary account of the inductive "steps." In giving the more detailed account of inductive method which is to follow in the next topic, that criticism will be resumed, while at the same time we shall indicate a point of view which gives both unity and dynamic character to the series of "steps" involved in reflective induction. We shall take the case of the logical formation of the class concept as the simplest illustration for the purpose of showing the nature and relation of the distinguishable phases, or "steps," in inductive method, leaving for a later chapter the discussion and interpretation of the hypothesis as a characteristic of inductive method.

3. Inductive Method,—the Inductive "Steps."

(1) Observation.

The term observation is here used to include the whole process of gathering particular facts, whether it be through further perceptual processes, through inquiry, or through reading. As we have already indicated in an earlier chapter,

in our study of the concept, the ordinary account of observation gives no suggestion of a *principle* in accordance with which the individuals to be observed are *selected.* Observation is not a random process, taking account of any and all individuals. As a matter of fact, the individuals are selected from a more or less definite point of view. Whence this point of view? It is furnished by that core of meaning which is embedded in the corresponding psychological concept. That concept has broken down, failed, or become inadequate; it is problematic at some point. Observation, to be of any value, must be relevant to the particular problem, and the nature of the problem is determined by the psychological concept which is to be reconstructed. Hence the previously existing psychological concept must inevitably function in the process of investigation, guiding and directing its course through the whole series of inductive "steps." As applied to observation this means that we select individuals for observation which we have been accustomed unreflectively to bring under the previously existing psychological concept, supplemented now that we are in doubt by such other individuals as we feel might probably be brought into the same group.

To make our thought more concrete, let us take the illustration of attaining the logical concept trade center, which Mr. McMurry so suggestively works out on the pedagogical side in his *The Method of the Recitation.*[1] We shall study it more particularly for the sake of making clear the psychology of the process. Mr. McMurry starts out with the detailed study of Minneapolis and its environment. When this study begins has the child no idea at all of trade center? Most likely he has been studying geography for some time, and he has from his home geography, at least, formed some idea of trade and has seen trade centering in certain villages or towns rather than being scattered all over the neighboring region equally. Even such a vague

[1] Pp. 16-24.

idea as he might have of trade center would operate to vitalize his more detailed study of Minneapolis. But whether the child had or had not this psychological notion with which to start, the study of Minneapolis could not give him a logical notion of trade center. Its primary function would be to furnish the rich background of actual concrete detail out of which a reasonably virile psychological concept might emerge which should serve as the basis for the process of logical reconstruction. Having this psychological concept, it would now be possible for the child to suggest other individuals for study; for he now has a point of view for making selections. At least some already existing concept, either in the mind of the child or in that of the teacher, must be brought into use in order to make any selections of individuals for observation that is not purely random.

We may now ask, "But what motive is there for this process of further observation of individuals?" The child applies his notion trade center, either of his own accord or under the guidance and direction of the teacher, to other cities such as Chicago, Pittsburg, etc. From his study of Minneapolis he has associated with the meaning of trade center the idea of waterfall, of lumber industry, of flour mills, etc. In applying his psychological notion to these other cities he finds that it does not work in all respects. It is inadequate in its application to Chicago; for this city has no waterfall. It is inadequate in its application to Pittsburg; for this city has no lumbering industry. These cities, and perhaps many other individuals, must be observed, and the idea of trade center reconstructed. The breakdown of the psychological concept trade center is the stimulus to further observation and furnishes the motive both for this observation and for the "step" of comparison. At the same time, there is a core of meaning involved in the original psychological notion which functions to define the problem sufficiently to determine the selection of the

individuals for more reflective investigation and to give guidance and direction to all the processes involved therein.

(2) Comparison.

The ordinary account does not suggest any principle in accordance with which comparison proceeds when the individuals have been selected. When we compare, it is not for the sake of noting all likenesses and all differences. Such uncontrolled comparison would be felt to be absurd and fruitless. Again, here it is the already existing psychological concept which furnishes a point of view for comparison. We compare the individuals from the point of view of the central core of meaning, even though it is now felt to be vague and problematic, which is involved in the psychological concept that is undergoing reconstruction. This furnishes some sort of a standard, though itself subject to modification, for testing the relevancy to our problem of certain likenesses and differences. The process of comparison is, then, not aimless, but falls within the limits of a problem that is at least vaguely defined.

When Minneapolis and Chicago as trade centers are compared, we do not compare them with reference to their school systems or their method of lighting the streets. The point of view furnished in our psychological concept instantly rules out such lines of comparison. It is at least definite enough to focus the problem of comparison somewhere within the field of relevancy. We are apt to choose for comparison those points in which there is some sort of a possibility of trade factors being involved, such as the character of the surrounding country, the facilities of communication of various sorts which are concretely familiar to us, etc.

(3) Abstraction.

Again, abstraction is not merely the selection of *common* qualities and characteristics. It is rather the selection of *essential* common qualities. But how shall we have any idea of what are essential common qualities? Only as we

have some point of view for judgment. This is furnished by the underlying psychological concept which functions to give direction to our investigation. Qualities are essential only in so far as they meet the needs of the *problem* in hand. The logical concept to be attained must have that core of meaning which shall make of it an efficient tool in the control of individuals either in action or in thought. Only qualities or characteristics which are thus regarded as essential are abstracted, no matter how many others are common.

Minneapolis and Chicago may both have good school systems, they may both be lighted by gas, or both by electricity. Possibly the average height of the inhabitants of both cities may be the same, etc. But we all feel at once the irrelevancy of this set of common qualities. Why? Because we have enough of an idea of trade center embodied in our psychological concept to know that these common qualities or characteristics are *not within the field of our problem.*

But both cities lie within a region that needs to be furnished with supplies and that also needs to get rid of raw materials; both cities have excellent railway communications with various parts of the surrounding country; both cities have water-ways suitable for the transport of goods; both cities are engaged in receiving raw materials, converting them into manufactured articles, and sending them out to other places for consumption; both places serve as centers for the collection and redistribution of various kinds of products. In the process of comparison, we run across many such common characteristics which we instantly feel are relevant to our problem. We focus our attention upon these and hold them in mind.

At the same time there is a process of elimination of the apparently relevant that takes place. We find the waterfall at Minneapolis an important factor in making it a trade center, but there is none at Chicago. We find a

river at Minneapolis, and a great lake at Chicago; water in some form seems very relevant. Perhaps it is essential. We compare with Birmingham, Alabama, and see that this is a great trade center of the South, but an inland city, relying wholly upon railways for its commerce. Now if, through our study of Minneapolis first, we had included in our psychological concept trade center waterfalls, river, and lumber industry; in the process of comparison these elements would have been eliminated as elements which belong in the essential core of meaning. This is the negative aspect of abstraction.

Abstraction proper consists in the selection of those common characteristics and qualities discovered in the process of comparison which are judged to be essential from the point of view of our problem, the withdrawing of these from the tangle of complex details and the holding of them off before the mind for separate consideration.

(4) Generalization.

This does not consist merely in massing together the common, or even the essential common, qualities of all the individuals into one complex,—a sort of composite photograph affair. It does consist in setting up under the control of a single image the abstracted essential qualities as a *standard,* as a central core of meaning, by which to judge and interpret all the individuals of a group. Under one image are organized a system of meanings which serves as a *rule* for the determination of all the individuals of a class. The outcome is that this image more adequately symbolizes the appropriate reaction, mental or motor, to all the individuals of the group.

When we have gathered together the characteristics which are essential to a trade center,—that it shall be a place which receives and transmits goods, that it shall have facilities for the conversion of raw materials into manufactured articles, that it shall have suitable means of conveyance by rail or by water from one place to another,

etc., we set up these abstracted qualities, organized into one whole, as a *standard,* or rule, which we apply to every city to determine whether it is a trade center or not. *The act of mentally asserting that this core of meanings does constitute the standard,* and that every city that shall be called a trade center must conform to the standard of possessing these characteristics,—*this act is generalization.* Generalization is, then, a far more constructive and a far more dynamic and purposive process than any sort of mental composite photography.

4. Interrelations of the Formal "Steps."

It should be observed that the "steps" of observation, comparison, abstraction, and generalization are not absolutely separate and distinct. Their arrangement in a definite order is more or less formal, useful for the purpose of description. They overlap and interpenetrate one another in the actual thinking process. But they represent essential movements within the inductive process. The term phases would be a better term to employ than the more popular term "steps." To indicate that we are using the term "steps" in a popular and loose sense only, we have employed quotation marks.

Observation is for the sake of comparison, and comparison may be simultaneous with observation, each exercising a determining influence upon the other; comparison is for the sake of abstraction, and a certain amount of abstraction may go hand in hand with comparison; abstraction is for the sake of generalization, and generalization is not all done at one time,—it weaves to and fro with the process of abstraction. Indeed, the whole series of processes may be gone through repeatedly in whole or in part, resulting in repeated modifications of the general notion, before the reflective reconstruction of the concept is complete. In this connection, it may be pointed out that application, or testing, of the concept by using it to interpret or control indi-

viduals, which is really a deductive procedure, is an integral part of the whole process of generalization, and this too may be repeated many times before the satisfactory logical concept is attained.

While the idea of inductive method as a series of steps, each one complete in itself before the next is entered upon, breaks down; it still remains true that there are certain characteristic phases, or movements of thought, in the inductive process each one of which is necessary in some degree of its fulfilment to the next. These phases within the inductive movement of thought are bound together, guided, and directed by a common point of view which dominates the investigation throughout. That point of view is furnished by the central core of meaning embodied in the psychological concept which is being reconstructed. For example, the previously existing psychological concept trade center in our illustration functioned to guide and direct the various "steps" of investigation so that one "step" led rationally to the next and the results of one were directly relevant to the one which followed.

The line of thought which we have just developed is pedagogically significant in suggesting that there can be no true inductive process for the pupil until he has first gained a reasonable background of psychological notions which shall serve as the basis for the emergence of real problems and which shall also furnish guidance and control to the process of investigation. The relevancy of the inductive "steps" to one another cannot be felt by the pupil except as he has been made conscious of the nature of the problem involved. If the problem is given to him outright, it is purely formal, and all the steps in its solution are formal. It can be made real only by first developing something of a psychological notion out of the application of which the problem may naturally spring. If this is done, then the series of "steps" involved in inductive method may become relevant and dynamic.

5. Induction of Laws and Principles.

The same general point of view which we have developed in our discussion of the inductive process in its application to the class concept applies also to the case of laws and principles. We arrive at many laws and principles unreflectively, as, for example, the general law of plant growth, the law of the condensation of vapor, the principle that money is a medium of exchange, the principle that repetition fixes habit, etc. In the realm of laws and principles, the process of attaining logical notions is one that is subject to the same conditions as in the case of the class concept, namely, the breakdown, or failure in practice, of some psychological notion. This is the motive for the investigation of individual, or particular, cases with reference to the reconstruction of the law or principle. And the series of inductive "steps" is the same as that already described. Sometimes, however, the breakdown of existing unreflective, or even reflective, notions is so complete that the guidance and direction of the inductive process is under the control of an hypothesis. The nature and function of the hypothesis we reserve for treatment in a later chapter.

6. Unreflective Deduction.

Deduction, like induction, as a movement of thought may be unreflective in character. Psychological concepts may not only arise unreflectively, but they may also be used unreflectively. In applying them as accepted and unquestioned to the interpretation and control of individuals we are proceeding deductively. This we are almost certain to do unreflectively in the case of psychological notions. But even if our concepts are logical, we may make an unreflective use of them.

A boy comes to a chestnut tree. He sees that the burs are opening, and he expects to find chestnuts on the ground. He has a general idea of the habit of the chestnut tree at this season of the year. In harmony with that accepted

idea he interprets this particular situation. The movement of his thought is deductive. But it is not reflectively so; for he does not reflectively utilize the ground of his inference, or bring it forth explicitly from the background of his consciousness. The concept is, however, applied and determines both his thought and his action. The fisherman sees a pool in the stream which has certain well-marked characteristics familiar to him whereby he instantly infers that it is a good place to cast his line for fishing. There is a ground, or reason, for his expectation, but that reason may not operate reflectively. My general notions of courtesy, of business honesty, of reverence in church, etc., may determine my thought and my action in a thousand details. In every one of these cases there is doubtless a reason which could be pointed out, but as a matter of fact that reason operates quite unreflectively. There is the application of the concepts, their use in guiding and controlling both thought and action. In other words, there is a deductive process, but that deductive process is unreflective in character.

7. Reflective Deduction,—Deductive Method.

We may say of deductive method, as we did of inductive method, that it is not a pure invention of the scientist and the logician. They have merely made explicit what is everywhere implicit in the use of accepted general notions to control thought and action. It is the characteristic of deduction as a method to make explicit the ground of all inferences. The specific device of deductive method for the reflective control of the whole process is the syllogism. The discussion of this is deferred until a later chapter.

Deduction, we have said in an earlier place, operates within a system of already organized knowledge. This does not mean that every part of that system is perfectly clear and explicit. Deduction operates within the system to clear it up and bring to light many things of which we were not

conscious and which we could not be said to know. There are two characteristic aspects of ~~inductive~~ method: one the deductive explanatory, the other the anticipatory. The explanatory aspect of deductive method takes some fact that belongs to a system and gives a reason for it, or justifies the fact on the basis of what we know about the principle of organization of the system to which the fact belongs. A few illustrations will make this plain. Here is a particular region in western Colorado. We find that it is dry and unproductive. Why? Because the moisture-laden winds from the Pacific ocean in crossing the Rocky mountains rise into higher altitudes, cool off, and deposit their moisture before they descend to the eastern side of the mountain chain. Here the isolated fact is explained by reference to a principle which applies to the whole system of facts to which it belongs. We call Florida a peninsula. Why? Because it is a portion of land nearly surrounded by water, and connected with a larger portion by a neck, or isthmus. The word James is a proper noun. Why? Because it is the name of a person. Six eighths equals three fourths. Why? Because when both terms of a fraction are divided by the same number the value of the fraction is unchanged. Here facts are justified by reference to controlling principles of the organized systems to which they belong.

Deductive method may be concerned also with the anticipation, or discovery, of facts which we do not know. I may not know that western Colorado is dry, but I may know that moisture-laden winds which pass over high mountains deposit their moisture on the near slope. Looking up western Colorado on the map, I find that it belongs to a system of geographical fact in which the ocean breezes are intercepted by a high range of mountains. I anticipate, then, or infer, that western Colorado will have a dry climate. This anticipation can be verified by actual observation or by consulting an authority of some sort. I have a triangle all of whose sides are of the same length. Here

a part of a system of fact is given. By the proper use of certain principles which have already been established, from this data I can discover the fact that the angles of this triangle are all equal. The inherent relationships within the system of geometric fact are such that I can pass from one part of the system deductively to another by means of certain general truths already proved or given by definition or construction. Knowing that in the American Revolution at a certain period the British have determined to separate the colonists into two groups which cannot assist each other, and knowing the details of the colonial life at that time, I can anticipate what the British plan of campaign will be. Of course they will seize upon the Hudson river valley as the strategic point of their campaign. Reading up on the subject, I find my inference to be correct. In every department of life, whether that of school study or that of practical affairs, organized knowledge may be used to anticipate or discover something more. Deductive method makes explicit the steps of inference throughout the whole process by which these anticipations, or discoveries, are attained. The grounds of all inferences are brought out, the reasons are stated.

8. Pedagogical Importance of Deductive Method.

Inductive method has received relatively more attention from the teaching profession for some time than deductive method. Deductive method has fallen into disgrace because of its abuse on the formal side. But there is a normal and natural place in instruction for deductive method. The goal of instruction is not the attainment of general notions,—of class concepts and laws,—but the power to use them in controlling experience. Deduction is, after all, the practical side of thinking. The child needs training in deductive processes as well as in inductive. There is abundant opportunity without degenerating into formalism to employ the principle of deduction in both its explanatory and in its

anticipatory aspect in every school subject.[1] Most interesting development lessons involving the anticipatory type of deduction can be worked out, as has been hinted at above, in geography, in history, and in mathematics. In using his organized body of knowledge to control thought processes which shall yield additional knowledge, the organization of fact itself becomes more definite and clear, and the concepts and laws which the pupil has become freer and more flexible tools of the mind in the control of experience.

9. Significance of Inductive and Deductive Method from the Point of View of Control.

It is evident that induction and deduction, when the processes are of the reflective type, represent highly organized and controlled methods of procedure in thinking. As methods which have been worked out and mastered so that they are the permanent property of the individual, they become, as it were, complex and very powerful tools for him,—tools which he may use in guiding and directing his thought processes to make them accomplish his purposes more efficiently. All the organized methods of doing business which the merchant has mastered are special elements of technique, or tools, which he employs to facilitate his business and give him added control over its problems. In like manner, organized methods of thinking, like induction and deduction, become powerful mental tools which facilitate the business of thinking and make the control of its problems more complete and adequate. From the biological point of view, this added power of the thought process means added power in the control which the individual is capable of exercising over every phase of his environment.

[1] *Cf.* Bagley, *The Educative Process,* Chapter XX.

CHAPTER XX

INDUCTION AND DEDUCTION VIEWED AS TECHNIQUE OF THINKING

(Continued)

1. The Special Device of Deductive Method,—the Syllogism.

(1) General relation of the syllogism to deduction.

It is usually considered that the syllogism is the specific and characteristic element of technique in deductive thinking. This is true in so far as deduction is not made fully *explicit* except as it involves a process of verification, or proof, in which the *ground,* or reason, for each inference or transition in thought is *explicitly pointed out.* The syllogism is the special device for making sure that deduction is correct. It is always a phase of fully reflective deduction. But to describe even reflective deduction wholly in terms of an analysis of the syllogism, important as the device may be, would be to describe it in terms of an analysis of the finished product only and to ignore the dynamic side of the process. There is, as we pointed out in our illustration of geometric demonstration, even in reflective deductive thinking, a very large amount of tension and strain of the mind in the process of searching for and evaluating facts relevant to the solution of the problem. Connections of thought have to be made at the cost of much struggle and stress of mind. These connections of thought are exhibited in the formal demonstration only *after* they have been made.

(2) Illustration.

Under ordinary conditions, if I were traveling through the woods, and, while hungry and thirsty, came upon some

berries, there would be a natural impulse to react in the way of plucking and eating the berries. But if they had in them some elements of unfamiliarity, I should hesitate. The individuals have now become problematic, they need interpretation. Are they edible berries? If, on closer examination, I can identify them as falling under the familiar notion blackberries, then they are interpreted, *i.e.,* their place and function in an already organized system of knowledge has been made explicit. They are no longer problematic individuals, and the appropriate reaction is freed and may take place in the manner which is habitual for such a situation, without any further thought. The thinking involved in meeting this situation is essentially deductive. A problematic situation has been met by the application of a familiar and unquestioned concept.

But if the question should still further arise as to whether my interpretation were right or not, we would have the condition which calls for syllogistic reasoning. The whole process might then be gone over again and be thrown into the following form, in which the *points of connection* in the thinking process are all made *clear and explicit* so as to avoid any possibility of error.

All blackberries are edible.
These are blackberries;
Therefore they are edible.

(3) Function of the syllogism.

The syllogism just worked out is only one of many possible forms, but it is illustrative of what is essential in every form of the syllogism. If this book were dealing with the logic of thinking rather than with the psychology, it would be interesting to take up the various forms of the syllogism. But for our purpose it is sufficient to say that the primary function is the same in every form of the syllogism, namely, to point out and make explicit the relation between the general and individual notions employed in making the transi-

tions of thought, particularly to make clear the ground of all inferences. In many cases of deductive thinking, especially in those involving great complexity or subtlety of thought, it is very important to verify conclusions by means of the syllogism.

It is to be noted that the function of the syllogism is to verify thought processes in making transitions from one judgment to another by inference. It does not establish the truth of the original premises. All that the syllogism given above can do is to test the validity of the reasoning, provided the first two propositions are true. If I have been careless in my observation of the berries and have overlooked some of the essential marks of identification of them as blackberries, my syllogism does not help me any in that matter; I may be poisoned by the berries just the same. The fact that the syllogism tests only the reasoning process and not the truth of the premises is made the basis of a specific method of proof in geometry, namely, the method of "Reductio ad Absurdum." Here correct reasoning gives a conclusion which we know to be wrong; hence we know that one of the premises is false.

(4) Illustrations of functional nature of the syllogism.

Mr. James has admirably pointed out the fact that deductive reasoning is teleological.[1] That is, it is functional. This is seen in the fact that the syllogism takes particular form according to some interest or need of the individual. The idea of the conclusion,—in the syllogism given, the idea of eating,—dominates the whole process. In another situation the dominant idea might have been something else. Perhaps I am curious to know whether the berries are getting ripe. I notice then that they are turning red. Redness is now the essential mode of conceiving the situation; for I know that when blackberries turn red they will soon turn black and will then be ripe. My syllogism then becomes: These blackberries are turning red; when black-

[1] James, *Psychology,* Briefer Course, p. 358.

berries turn red, they are getting ripe; therefore these blackberries are getting ripe. In the first situation it was important that I conceive the berries as blackberries. The conceiving of the situation as a blackberry situation was the heart of the whole reasoning process. In the second situation, where the problem centered in the question of ripeness, that mode of conceiving of it which made the solution possible was redness.

Let us take one more case in which the principle is more strikingly exemplified. William Adams is a poet. About all that he seems to be interested in is gathering about him the finest library of poetical works that he can collect. He suddenly falls heir to a sugar plantation. What an embarrassing situation! What can he do with a sugar plantation? To run a sugar plantation will take him away from his dominant interest in poetry and plunge him into a life of disagreeable oversight of negro workmen and subject him to the tedium of days in the southern heat. The solution comes through conceiving of the whole situation in terms of money. Money will purchase leisure and libraries of poetical works. Using Mr. James's terminology,

> The concrete datum S is sugar plantation;
> Its essential attribute M is money;
> The attribute's property P is poetry.

Money serves as the middle term by which poetry can be gotten out of sugar plantation. The fact that poetry was what was desired made it useful to conceive of sugar plantation as money, although it might have been conceived in other ways equally good, if the problem had been different. The problem might have been one of health, or of efficient management, etc. Then a different mode of conceiving of the situation would have been necessary.

To return to our illustration, if this reasoning is thrown into syllogistic form, we have the following sequence of propositions:

Sugar plantation is money; (S is M;)
Money is poetry; (M is P;)
∴ Sugar plantation is poetry. (∴ S is P)

The psychology of deductive reasoning, according to Mr. James, is practically summed up in the sagacity of properly conceiving S as M and the learning, or ability, to recall M's consequences. It is these two things that give the ability to deal with novel data.

(5) Psychology of deduction inadequate in terms of analysis of finished product.

Whatever else we may get out of these illustrations and the discussion of Mr. James regarding the teleological aspect of reasoning, this at least ought to stand out quite clearly, namely, that the syllogism is only a formulation of the results of thinking for the purpose of exhibiting what has been achieved and seeing that all the connections of thought are valid. The real tension of thought, the vital part of it all, is conceiving of the situation in terms of some idea that suggests consequences which are relevant to the solution. No true psychology of the deductive process of thinking can be written wholly in terms of an analysis of the syllogism into a series of judgments and these judgments into a comparison of concepts. The analysis of the finished product does not reveal the intensity of the actual mental processes which were most vital to the solution.

2. THE SPECIAL DEVICE OF INDUCTIVE METHOD,—THE HYPOTHESIS.

(1) General relation of the hypothesis to induction.

In our discussion of the method whereby logical concepts are attained, which we worked out in detail in the case of the concept trade center, we have already virtually described the method of induction. We noticed that it consists in a highly organized group of processes,—observation, comparison, abstraction, and generalization,—which are gone through purposely for the sake of reconstructing a general notion. The principle is the same whether the general

notion is a class concept or a principle or a law. But there is one element of technique in the inductive process which we have not discussed, namely, the hypothesis. This deserves some special attention. We shall try to interpret it from the point of view of functional psychology rather than from the point of view of logic.

In many cases calling for the inductive movement of thought, the inadequacy of the organized system of knowledge is so great that the reconstruction of our concepts amounts practically, and in the popular sense, to the attainment of new general notions. But even here the investigation of individuals, or of specific particulars, under the heads of observation, comparison, etc., cannot go on in a random fashion. There must be some point of view for selecting whatever is to be observed, some guiding principle of comparison, some clue as to what are essentials in the process of abstraction. Any kind of progress demands some principle of control for the movement of thought. As a matter of fact, the problem is always limited to a certain extent by falling within some particular field of investigation. It has some fundamental character as a problem. In other words, the very fact of a problem at all presupposes some particular feeling of need, some idea of the relevancy of certain elements and the irrelevancy of others, some sort of a goal to be attained. All of these things, however, may be very vague and tentative. But they do argue the presence of some sort of a system of knowledge within which the inductive thinking process is at work. There is a movement of the mind toward some more adequate organizing principle for this system of knoweldge, and the mind is in a very delicately receptive mood for the welcoming of any idea within a certain field of relevancy which is capable of serving as such an organizing principle. Now, when the mind does seize upon some idea confessedly as a tentative principle of organization and interpretation of

the individuals under investigation, we call that idea an *hypothesis.*

(2) Illustrations.

The hypothesis is not a strange device. It is a tool of thinking in ordinary, everyday, practical situations. Here the scientist found it and then specialized in its use and made it a reflective tool of investigation.

I am nearing the entrance of a strange town. I see crowds of people moving in the same general direction. In the distance I hear considerable noise. Something is going on in town. What is it? I think of possible explanations of the situation. Is it a football game? Is it a circus? Either of these ideas may be used as an hypothesis. Suppose we take the first. It is a football game. What is the use or function of such an idea? I don't know any better now than I did in the first place exactly what is going on. What is the use of "guessing"? But this idea serves as a guiding principle in my investigation to find out. I know what to look for. I begin to be on the alert for signs of college pennants in the hands of passersby; I look for ribbons displaying college colors; I observe the people to see if there are groups of young people who look like college boys or college girls. As I approach nearer, I listen for the sound of college yells. My investigation of particulars is not a random process. I follow up clues of a certain sort. They may confirm me in my hypothesis. If they do not, I must start over again; but at any rate, I have disposed of this possibility. And it is quite likely that if my observations have not been confirmatory of the first hypothesis, I have at least gotten some clue as to the direction in which I must reconstruct my hypothesis to make it conform more nearly to a correct principle of interpretation.

The police, in dealing with the problem of discovering the individual responsible for a crime, must make hypotheses to guide and direct their investigations. They cannot

profitably examine all the individual men and women in the community, nor can they advantageously explore every nook and corner of the city. The firemen working on a burning building judge from certain indications what are the critical points in their attack upon the flames, and they work from that hypothesis until they find that it is not adequate to control their activities effectually.

(3) Function of the hypothesis.

The function of an hypothesis is to control investigation. Its value depends upon the number of relevant facts which can be deduced from it. If there were a football game going on, I had a right to infer, or deduce, that there would be pennants on display, that there would be college yells, etc. On the basis of these deductions, I observed, I watched to see if the facts tallied with my deductions. In so far as they did, I felt confirmed in the adequacy of my hypothesis. It might even be that I should be justified in asserting that there was a football game, even if I could not push my observations far enough to see the game itself. The establishment of an hypothesis consists in the agreement between the deductions which it makes possible and the observation of facts. Its acceptance depends on its ability to explain, interpret, and control individuals. Its functional significance consists in the fact that it brings into a situation that is problematic a controlling general idea on the basis of which investigation can proceed in a definite and orderly way while we are reconstructing some shattered or inadequate system of knowledge.

Let us take another illustration. Suppose that I am out walking and come upon a group of boulders. I notice that they are exceptional in character. They do not seem to belong to the strata of rock common to the region. How did they come to be here? Perhaps they have been brought here for building purposes. But the whole surroundings make this hypothesis seem unlikely. I wonder if they are not glacial rocks. Though I had never supposed that this

region was glacial in character before, yet this idea is suggestive. I follow up the hypothesis. Let us see now how it will function to determine my investigation. If these are glacial rocks, it is quite likely that I shall find them marked by the characteristic striæ, or scratches. This deduction I proceed to test. I examine the rocks for evidence of striation I find them quite plainly marked when I have examined them closely. Again, if these are glacial rocks, there ought to be other evidences of glacial action in the vicinity. On the basis of this deduction, I proceed to examine the stratification of the soil in the vicinity. I find that it has the well-defined characteristics of glacial drift. Still further, if these are glacial rocks, they must have come from some definite region where there are rocks of this kind. On the basis of this deduction, I examine the rocks more carefully to see if there is any evidence to be found of the direction from which they have come. On examining the striæ quite carefully, I find evidence that the scratches on the bottom of the rocks were made from south to north, that is, they have scraped over fixed rocks in going from north to south. I find also that the scratches on the upper surface of the boulders indicate that smaller rocks have passed over them from north to south. It is evident, then, that these boulders came from some place farther north. Now are there any rock strata of this character farther north? If these are glacial rocks, there must be. I look the matter up in a geological work, and I find that there are such strata of rock farther north and none in this whole region where I find the boulders. I am convinced then that my hypothesis is correct. That these boulders have been deposited here by a glacier seems certain.

At this point it ought to stand out clearly that the function of the hypothesis was to give definite guidance and direction to the investigation whereby I was to solve my problem. This guidance came largely through the fact that, on the basis of the hypothesis, there were certain things

which I had a right to infer. Thus my investigations were confined to specific lines of observation instead of being rambling and aimless. The hypothesis serves, for the time being, as a tool for the control of action and of thought the same as any general notion. Only, it is held as tentative during the process of investigation.

(4) Problem of conceiving hypotheses.

The most vital and crucial part of inductive thinking is that of conceiving fruitful hypotheses. The thinking process has not yet been brought under such perfect control that we have any sure method for securing the emergence of the right hypothesis when we are in need of one. All that we can do in the way of controlling this part of the thinking process is to familiarize ourselves so thoroughly with all the facts relevant to our problem that we are in the mental mood, or attitude, for the associative mechanism to work freely through all the material and to suggest subtle relationships which we had not hitherto suspected, or to bring out into reflective consciousness connections which had hitherto been vague and unreflective. In the tension of mind involved in concentration upon the problem, the mind is more likely to catch up and hold to any fertile suggestion than it otherwise would be. In such times of tension a mind richly supplied with facts relevant to a problem often seems to work on ball bearings, as it were.

It is often said that the first hypothesis is a sheer guess. From what has just been said, it can readily be inferred that I do not wholly agree with that idea. Yet it is true that there are some marks of the guess about the hypothesis in that we have no absolute rule that can be applied for the purpose of leading up inevitably to the right hypothesis. But from the whole psychology of thinking as worked out in this book, is the hypothesis aspect of thinking essentially different in this respect from any other aspect of real vital thinking? In those phases of the thinking process which consist wholly in the summing up of results and in throw-

ing the whole process over into the form of a finished product, it all seems so easy that we are deceived as to the nature and extent of the control which we exercise over the exact movement of thinking and we suppose it to be greater than it really is.

(5) Establishment of hypotheses.

If the reader will recall the illustrations of hypothesis already used, he will see that the establishment, or verification, of the hypothesis involves its use to interpret, explain, or control facts. In the case of the isolated boulders, the hypothesis that they were of glacial origin, so far as this region was concerned, was an hypothesis that *worked.* It could be used as a principle for the interpretation and explanation of a whole host of facts relevant to the situation. The consequences deduced from it tallied with the facts of observation and already established knowledge. In the illustration of football, the verification of the hypothesis was of the same sort.

In most cases of a scientific character, the conception and the verification of an hypothesis are not so simple as our illustrations would seem to indicate. The first hypothesis that is felt to be fruitful in its suggestiveness, when applied to facts which fall legitimately within the compass of the problem, often fails to explain or interpret them. Deduction of consequences from the hypothesis does not agree with known facts of the situation. In this case the hypothesis must either be rejected or it must be reconstructed so as to be adequate in its control of this resisting fact or body of facts. This often involves but little modification or limitation of the hypothesis, and again it involves very great modification. Whether the hypothesis is modified, or whether a new one is formulated, in either case it must be applied. And this process must be repeated until an hypothesis is found which will adequately control all the facts relevant to the problem.

So long as the controlling idea in a process of investiga-

tion is in the *experimental and tentative* stage of its development we call it an *hypothesis.* If it seems to be fruitful of results, yet we do not wish to imply that it is altogether satisfactory or fully tested, we often refer to it as a *working hypothesis.* If we have reached the point where we no longer regard it as tentative, but satisfactory, we call it a *concept,* a *principle,* a *law,* or a *theory,* according to the degree of its generality or the width of its application. Thus, we speak of the concept of house, a principle of percentage, the law of falling bodies, the theory of evolution.

3. Complete Induction Includes Deduction.

There is a sense in which deduction can be isolated from induction. There are certain problems whose solution demands only the application of already established and accepted concepts within a definite organization of knowledge. For these deduction may be adequate. But induction cannot be isolated. It is always inclusive of deduction. We have seen that hypotheses are not established, that general notions are not perfected, except as they are deductively applied in some way and found capable of interpreting and controlling particulars. Furthermore, our discussion has made it evident that in many cases the first hypothesis is vague and tentative in the extreme. The process of its development is through application and reconstruction repeatedly. In these cases deductive processes are inextricably woven into the very fabric of the inductive process.

4. Applications to Teaching.

(1) Training in thinking must recognize the dynamic aspect of inductive and deductive processes.

Logical power cannot be developed merely by going through the *forms* of induction and deduction. In our illustration from geometric demonstration (deduction) and in the illustration of the manner in which the logical concept trade center was attained (induction), we have seen that the actual movements of thought involved a great deal

of tension and struggle of mind. The ransacking of one's mental resources and intense processes of judgment are characteristic of real induction and real deduction. The method of instruction employed by the teacher, if it is to yield fruit in training the power to think, must not be so carefully controlled and directed as to leave no room for the child's mind to struggle with the problem on his own account.

In both forms of thinking, the starting point is something problematic. Neither of them can have any real motivation unless the problem is felt by the child. Unless the nature of the problem is rightly conceived, neither of them can have anything of teleological character, that is, they cannot be truly voluntary. If this is so, they are not processes which move directly toward any goal, and they cannot be in any right sense of the word processes of conscious adjustment of means to ends, they must be more or less aimless, arbitrary, and artificial, if not purely imitative.

In genuine, full and complete inductive and deductive processes, the conception of the real nature of the problem is more vital than any idea of the formal order of steps in the process. The mind that really grasps the problem will inevitably hit upon the order and nature of the steps in the thinking process relevant to that type of problem. Having hit upon the order and nature of the steps in simple situations, the formal aspect of the process can be brought definitely to consciousness by instruction; and training can be given in the perfection of the technique of procedure as a tool to more rapid and more effective solution of problems. But, in early training at least, there can be no doubt that more attention should be given to getting at the locus of the problem and less attention given to the question of whether we shall proceed from the general to particulars or from particulars to the general.

(2) We must recognize the child's system of already

organized knowledge as a determining factor in his thinking processes.

Both induction and deduction, as we have seen, work within systems of knowledge. The child's system of knowledge is vaguer and less logical than that of the adult or of the trained thinker. We must not, then, apply the teacher's standard of deduction or of induction to the thinking of the child. A process of thinking that would be very unsatisfactory from the teacher's standard of essentials may yet be very really and genuinely a thinking process from the standpoint of the system of knowledge within which the child is working.

Every time the child is asked a reason for a statement which he makes, and succeeds in basing it upon something else consonant with his experience, he has been going through a true process of deduction. His reason may be very unsatisfactory in the light of our knowledge; but if it is a reason which is harmonious with his system of knowledge and experience, then the thinking process is good. For example, the child may ask, "Why does the stone sink in the water?" If he is asked to say what he thinks about it himself, and replies, "Because it is heavy," that may be a very good answer for him. If there is a man in his neighborhood who is known to steal and to lie, and the child explains the fact on the basis that "the man is bad, that's why he steals," he is thinking deductively just as truly as if his explanation were better. If his thinking in these cases is based on reasons within his own system of experience and knowledge, it will not be a bit better as thinking if we compel him to carry it on a few points further in our terms so as to harmonize with scientific or ethical facts and principles which *we* know, unless these facts and principles are within the grasp of the child and have been taught to him. Here, as elsewhere in the teaching process, we may be altogether too anxious for the finished product and thus violate the fundamental principle of the thinking process

of the child, namely, that it is not vital and dynamic to him except as it operates within his *own* system of knowledge.

In cases where the child's answer is palpably wrong, even where it seems justifiable in the light of his experience and knowledge, we may do either one of two things. First, we may make it the occasion for further observation and reflection on his part and thus lead him to a reconstruction of his experience so that it will be adequate to the right interpretation of the case in question. In other words, the weakness in his system of knowledge is the natural occasion for a vital inductive process. Secondly, we may, if we feel that the child cannot be led to see the truth in more scientific terms, merely tell him dogmatically that his answer is wrong and give him the right one without explanation. This can do no harm, if we give him to understand that there is a reason and that he will some day be able to understand it. For example, if the child has come across the idea in some story that the earth is round, it is not necessary to give him a complete explanation of the grounds upon which we believe this to be true, if he questions it. We might better answer him dogmatically unless we are convinced that he will be able to interpret our explanation in terms of his own experience or knowledge.

Certainly any explanation that has to go outside of the child's own system of knowledge to get its binding force is valueless to him and may even be harmful. How much more genuine reasoning there would be among people if so many had not been deluded into supposing that they were actually thinking when they are only juggling with formulæ which are not an integral part of their system of knowledge! Otherwise intelligent people, by virtue of the fact that they possess and can manipulate a few catchwords of political, social, religious, or moral philosophy, are often actually held in bondage to fixed ideas and prejudices of every sort on the supposition that they have thought the problems through and settled them.

The teacher who follows up the statements of children with demands for their justification, within the limits suggested above, the teacher of the everlasting "Why?" is not only giving them constant practice in deductive thinking, but is also putting them in situations in which they feel the inadequacy of their present system of knowledge either in respect to the extent of its materials or in the matter of their organization for use. Thus he is putting the child into the most favorable attitude of mind for the welcoming of further knowledge given either through direct telling or gained through inductive processes. It is fallacious to suppose that because we work under limitations in the training of children to think, because we cannot push the inductive and deductive processes through in such a way as to satisfy our ideal of completeness and adequacy, the ideal of the finished product, therefore we cannot give them training at all in thinking, both deductive and inductive. If we do not give children training in thinking at the stage of their development in which the cruder forms only are possible, how can we expect them to grow up to the point of appreciation of the more perfect forms or to power in their use?

Suggestions previously made in our study of the development of the child's imagination would be relevant at this point. We must remember that the child's system of knowledge is one that is held together in large part by ties of connection that get their force from his interest in concrete wholes rather than by ties of connection that spring from the appreciation of far-reaching abstract principles. His training in inductive and deductive processes previous to adolescence, that is, in the period of the graded school, should be largely, then, within systems of knowledge in which cause and effect, conditions and consequences, are quite closely related within more or less concrete wholes. The period of the graded school, or the elementary school as it is now more commonly called, is one for the training in that kind of thinking which builds up the habit of looking

for principles which explain things. The period of adolescence, corresponding to the age of high school and early college education, should be one in which greater stress is laid upon the development of principles in their more abstract and general form. While this is being done, thinking may be led to assume the form of more consciously recognized inductive and deductive methods, and the technique of these processes may be finally perfected. The more abstract organization of knowledge into systems under the control of abstract principles makes possible and appropriate the more highly organized, more abstract, and more perfect forms of the thinking process. Here the goal should be more definitely held in mind as that of the finished product.

(3) Inductive method is not complete without deduction.

Much stress has been laid in recent years upon inductive methods of teaching. Our discussion of the inductive process has shown that induction is incomplete without deduction. So it must be with an inductive method of teaching, it is incomplete without its appropriate phase of application. From this point of view, the ideal method of teaching is spoken of as the inductive-deductive method. The idea of peninsula, trade center, etc., when once developed, must be applied in as many different kinds of exercises as possible. Only thus can these ideas themselves become perfectly clear. The principle in arithmetic must be applied frequently and in situations that are not identical, if it is to be mastered. So with any principle or law in physics, economics, or any other sphere of thought. This doctrine is doubtless so familiar to the reader that it needs no further emphasis at this point.

(4) Type studies give the opportunity to provide in school work for much of the dynamic aspect of the inductive process.

We know that most of the generalizations which lie at the basis of our sciences and of the scientific treatment of

all the subjects of the curriculum have been arrived at as the result of long and tedious investigations, in many cases covéring years or even centuries. The complete inductive process is one that we can by no means expect to reproduce in the schoolroom. Who would undertake to reëstablish the law of gravitation as a problem of original induction? But if the child does not go through with the stress and strain of struggling with the obdurate facts of the problem, has he not lost the dynamic character of the inductive process? Has it not become artificial and imitative?

It is evident that for school purposes there must be some compromise between the full inductive process and the mechanical process of teaching mere brute fact. May not the child go through enough of the inductive process to give vitality to his grasp of principles, to give a real appreciation of their value and significance? In the attainment of every important principle, there are certain critical points in the inductive process. The chief problems center at these critical points. The teacher, knowing in advance what these critical points are upon which the induction depends, may skilfully lead the child up to the point of facing these critical problems, both negative and positive. Squarely confronted by these critical aspects of the problem, even if he has to be told many of the facts relative to the solution, yet there remains much that is dynamic.

Mr. McMurry has so fully worked out the doctrine of type study and illustrated it so abundantly in his book, *The Method of the Recitation,*[1] that any extended amplification of the doctrine here would be repetition of his work. Hence, only enough will be given to suggest to those who are unfamiliar with the doctrine something of what we mean by it. Take the case of developing the idea of trade center for example, which Mr. McMurry discusses in detail. Minneapolis, Chicago, Pittsburg, and Birming-

[1] Chapters X and XI.

ham, Alabama, are good types. Minneapolis is studied in detail. But there is danger of some peculiar characteristic which stands out strongly, like the great waterfalls, being seized upon as essential when it is not. In the study of Chicago, which has no waterfall, this characteristic is eliminated. If commerce in wheat has been seized upon as an essential characteristic of trade center, then in the study of Pittsburg, whose chief industries center in the coal and iron trades, the idea of wheat as an essential drops out. If the idea of waterways has been seized upon as essential, then in the study of Birmingham that idea drops out. At the same time the common core of meanings is being emphasized through repetition in the variety of situations.

In the concrete and detailed study of a series of cities, like these, the processes of observation, or study of fact, of comparison, abstraction, and generalization have sufficient scope and free play to be genuine and vital, and the process of induction is not reduced to a mere form. By selection of material in which both the positive and the negative aspects of the problem are emphasized and accentuated, the possibility of arriving at the general principle within reasonable limits of time is assured. But at the same time there is left a pretty wide field for the activity of the child's own mind to function in the arriving at conclusions through a proper series of inductive "steps."

Mr. McMurry illustrates the use of types in the inductive teaching of principles of history, of morals, and of nature study, as well as geography. The principle is the same, but the practice requires more skill in some subjects than in others. The method is certainly very suggestive in relation to the problem of how to shorten inductive procedure and yet retain its dynamic character in the process of instruction.

CHAPTER XXI

JUDGMENT AS AN ELEMENT OF TECHNIQUE IN THINKING

1. Definition.

Judgment is that act of the mind by which we interpret some problematic experience by referring it to some idea derived from past experience. (Adapted from Welton.[1])

Judgment brings an idea to bear upon experience. It is an *activity*, a *mental process*. Judgment and proposition are not identical terms; proposition expresses the result of a judgment. Judgment is sometimes defined as a comparison between two concepts. Such a definition is the outcome of the analysis of the finished product,—the proposition. An analysis of the proposition shows two concepts related as subject and predicate. On the basis of this analysis, it is supposed that the mind compared these two concepts and then asserted a relation between them. Such a conception of judgment ignores the dynamic aspect of the process. It often happens that what we have to deal with is an experience which is problematic. It can hardly be said that there are two concepts to start with. But when the judging activity has succeeded in evaluating and interpreting this experience by the aid of a concept, the outcome is expressed in a proposition which indicates a relation between two concepts, one of which is subject and the other predicate.

2. Illustration and Explanation.

If I am busily at work with tools and suddenly discover that my finger is bleeding and evidently has been bleeding for some time, I am comforted with a problematic expe-

[1] Welton, *The Logical Bases of Education*, pp. 63, 73.

rience. How is the bleeding to be explained? I examine the nature of the wound. I look over my tools for indications of the cause of the wound. I find nothing in my examination of the tools that seems to be relative to the nature of the wound. I examine the wound more carefully, and finally I find in the bottom of it a splinter of wood. At once the situation clears up. I now remember that I experienced a little discomfort in quickly running my finger over a rough edge. Yes, I hurt myself on the rough edge of a board. That is my judgment. Indeed, it is only the culmination of a whole series of judgments. As for example,—I have cut my finger; I did not cut it with my saw; I did not cut it with my knife; perhaps I cut it with the rough edge of a board; I find a splinter in my finger; I remember that the rough edge of that board did not feel comfortable; I hurt myself on the rough edge of the board.

Now can any one say that judgment in this situation was a comparison of two concepts? That would presuppose two concepts *given* in the first place. Rather here is a problematic situation to be interpreted, and we must *find* the concept to apply to it which is capable of interpreting it. The whole process of tension and strain, including all the intensity of thinking, from the time that the situation is felt to be problematic until it is adequately interpreted, is judgment proper. But the judgment as an activity of applying to the problematic situation an idea derived from past experience may involve within itself many processes of judgment which deal with phases of the situation. It may involve within itself also perception, or further observation, memory, imagination, and thinking.

Judgment is a process of evaluating a problematic situation. It does not necessarily presuppose two concepts as given. A part of the judging process is finding the right concept to apply to interpret the problematic situation. The clarification of the situation brings out two concepts in

dynamic relations to each other,—one as subject and the other as predicate. Judgment set up the relationship between the two, or at least developed it and made it explicit. After this has been done and the judgment process is expressed in the form of the proposition, then it is possible to compare the two concepts and assert or deny one or the other. But to view this comparison of the two concepts as judgment would be to take the point of view of the finished product and to make the results of its analysis our standard for defining the whole process. This would ignore the most dynamic aspect, the tension and strain of mental activity, in the live judgment as it actually takes place.

3. Conditions of Judgment.

The function of judgment is called forth under conditions of doubt or uncertainty of some sort which interferes with reaction, mental or motor. It is then necessary for us to raise the question "What is this?" We have to evaluate the situation, interpret it, judge it with reference to what we shall regard as its essential characteristic for the purpose of dealing with it satisfactorily. When the situation is satisfactorily interpreted, then it is possible for the reaction to take place in accordance with the result of our judgment.

4. Further Development of the Nature of Judgment.

(1) Judgment in the application of accepted concepts.

It is not a real *live* judgment which ordinarily gets expression in the proposition, "This is a book." We do not stop to evaluate the experience. The object is familiar; there is *no doubt.* We know exactly how to deal with this book experience. We make the appropriate motor reaction or the appropriate transition in thought by habit. But if the question arises, "How shall I catalogue this book?" and we are uncertain whether it should be classed as metaphysics, as logic, or as psychology; then a real process of judgment is called forth. We try to bring the work first

under one of these concepts, then another, through a definite investigation of its essential characteristics. On the basis of our investigation we definitely evaluate the problematic situation, and we bring the book under the concept metaphysics. The act of judgment is then complete, and its result may be expressed in the proposition, "This is a book on metaphysics." It is evident that as soon as our judgment is complete, we know how to catalogue the book, that is, our method of reaction is determined. The illustration given is a case of judgment in which a well-defined concept, namely metaphysics, furnished the idea to which the problematic experience of cataloguing was referred for successful interpretation.

(2) Judgment in the process of building up concepts.

We have already noticed that in the process of building up concepts, as for example the concept of trade center, there was a constant process of evaluation, or judgment, going on. What is it that makes Minneapolis a trade center? Is the waterfall a factor? Is the river a factor? Is the abundance of forests along the river a factor? In the process of comparison of Minneapolis with Chicago, the relevancy of each one of these to the problem had to be judged, or evaluated. And in the process of abstraction there was further judgment as to just what characteristics were essential to the idea of trade center. Thus it is evident that not only is judgment a phase of the application of concepts to the interpretation of problematic experiences, but that it is also an important activity in the building up of concepts. In other words, it is the dynamic element in both deduction and induction.

5. Judgment and Thinking.

Whether our thinking be the inductive movement from individuals toward a more perfect concept, or whether it be the deductive movement of applying concepts to the interpretation of problematic individual experiences, in so far as

this process is active and dynamic, the vital aspect of the thinking process is judgment. Wherever there is an activity of mental reconstruction going on, there is judgment. This act of judgment does not seem to be describable in terms of a comparison of two concepts and a resulting affirmation or denial of connection between them. It is rather an analysis and development of some problematic situation with reference to the discovery of connections between elements of that situation and elements of previous experience, connections that we can take advantage of in seeing the situation from some point of view which shall give it meaning and put it under our control. Such processes of evaluation are certainly a very necessary phase of the ability to deal with novel data, which Mr. James regards as the very essence of the reasoning process.

6. Judgment Implicit and Explicit.

Many writers recognize a difference between judgments in terms of their implicit or their explicit character. This difference is analogous to the distinction between psychological and logical concepts. Implicit judgment, if we may use the term at all in speaking of judgment, is, like the psychological concept, unreflective in character; while explicit judgment is, like the logical concept, reflective.

(1) Implicit judgment.

If I hear the whistle blow and say, "It is noon," this is an implicit judgment. The situation presented by the perception of the whistle blowing is almost instantly cleared up by the application of the concept noon hour. Judgment always presupposes some ground for the interpretation given. In this case, the ground of inference is present, but it is used unreflectively and almost automatically. The inference is the outcome of a complex of very closely associated past experiences, including probably the daily repetition of the same tone quality of the whistle, repeated examinations of my watch on the occasion of the whistle's

blowing and finding that it was twelve o'clock, frequent experiences of eating my dinner immediately after the whistle blew, uniformly seeing the workingmen come from the factory at the signal of the whistle, etc. As a result of the close association set up between the various items of this complex of experiences, now, when I hear the whistle blow, this single item of experience may touch off any one or all of the other items of the complex immediately as an interpretation of the auditory experience. This immediate interpretation is likely to take the form, "It is noon." But it might take the form, "The men in the factory will quit work," or "I ought to eat my dinner now," or "If I look at my watch now, I can tell whether I have the right time, or not." These all might be implicit judgments, having a ground in past experience, but that ground being utilized unreflectively.

(2) Explicit judgment.

Suppose that I receive a letter. I look at the handwriting, and see that it is that of Mr. Jones. I notice that the letter is registered. I remember that Mr. Jones owes me some money. I conclude then, that Mr. Jones has sent me a payment on his note. If my judgment that Mr. Jones has sent me a payment on his note is consciously based upon these grounds, then the judgment is explicit. My judgment, "It will rain to-morrow," is explicit, if I base it on the recognized ground, "The wind is shifting to the south." All the judgments in a demonstration in geometry are explicit.

By an explicit judgment, we mean one in which the ground of the judgment has been brought out clearly. Such a case of judgment is called inference. The ground of the inference in reflective judgment operates reflectively in consciousness. Inference is judgment made explicit through pointing out, mentally at least, the ground, or basis, of the judgment.

7. Judgment and Other Mental Functions.

Judgment is *implicitly* involved in the percept, in the psychological concept, and in unreflective forms of thinking. It is *explicitly* involved in the logical concept and in all forms of reflective thinking.

If we are on the sea and some dim object looms up on the horizon, our percept of it is apt to be very vague, but the sailor quite likely sees it at once as a lighthouse, or as a vessel. What makes the difference between his percept and ours? Certainly not the sensory data; for we all have the same. But he has had a great deal of experience in judging, or evaluating, such vague experiences, so that now the process of evaluation works practically automatically and is swallowed up in the perception process. Here judgment is implicit in the percept. What is true in this case of perception is true in all our definite percepts of things. Judgment is implicit in every developed percept.

In an earlier chapter we gave the boy's concept of chestnut tree, of hickory tree, etc., as illustrations of psychological concepts. These concepts involve implicitly judgment. There is a ground, or reason, for calling one tree a chestnut tree and another a hickory tree, but in the conceptual process the ground does not operate reflectively. In the case of the logical concept chestnut tree, as we have already explained in our study of the logical concept, the elements of meaning have been brought explicitly to consciousness. What does this mean but that virtually in the formation of the logical concept a series of explicit judgments have been made? The logical concept summarizes, as it were, and condenses, or holds in solution, a whole group of evaluations of situations of the same general class or type.

Reasoning, as we shall see later, differs largely from less highly reflective types of thinking, in that the grounds of all inferences are explicitly pointed out, or that they operate reflectively in consciousness. Judgment, in reasoning, is explicit.

From this point of view, we see again the truth often pointed out before that in actual experience the various mental functions are not isolable, but they are inextricably interwoven and mutually involved. There are characteristic mental movements, characteristic organizations of different conscious processes, which are relevant to the performance of different kinds of mental work. These special functions we can study separately, abstracting, or drawing off, from the whole complex of conscious processes those only which enter into the special organization of activities which performs the function under consideration. To this functional organization of activities we can give a name indicative of the special function that is being performed. Thus, we may have attention, memory, judgment, etc. In studying special functions thus we do not necessarily suppose that none of the mental processes, or special organizations of mental processes, which enter into the complex for the performance of one function may not also enter into another complex in the performance of another function. The special mental activities involved in judgment, for example, run, either implicitly or explicitly, through the whole length of the intellectual life from its first step above raw sensation up to the most highly controlled processes of reasoning.

8. Judgment and Instruction.

We have seen that judgment is the vital aspect of every sort of thinking. Mr. Dewey calls it "the typical act of intelligence."[1] Wherever subjective intelligence is at work, there is some sort of evaluation of situations going on, there is judgment making or utilizing connections between the ideal and the real.

In the study which we made of concrete cases of thinking, we saw how important to the whole procedure was the process of judging and evaluating problematic elements, we

[1] Dewey, *Psychology,* p. 215.

saw how intense was the tension and strain of this process. If pupils are not to miss the vital aspect of the thinking process, it is important that they be left to do for themselves as much as possible of the interpretation and evaluation of problematic situations. In following through an organized thought process, as a formal demonstration in geometry, as contrasted with the task of constructing the same, the most vital part, that of judgment, is omitted. This has been elaborated in an earlier chapter.[1] If the reader will turn back to that earlier discussion, he will see the truth of it from a new angle.

Supplementary Readings for Chapter XVIII

Welton, *Logical Bases of Education,* Ch. 5.
Dewey, *Psychology,* pp. 213-20.
Creighton, *Logic,* Ch. 20.

[1] See Chapter XI.

CHAPTER XXII

THINKING AS REASONING

1. Point of View.

Reasoning and thinking are not mutually exclusive terms any more than square and rectangle are in geometry. Yet there is a specific difference in the one case as in the other; the terms are not complete synonyms. We can say that all squares are rectangles, but we cannot say that all rectangles are squares. The square is a particular kind of rectangle, one with its sides all equal. In like manner, we may say that all reasoning is thinking, but we cannot say that all thinking is reasoning. Reasoning is a particular kind of thinking, one in which there is exercised a superior control over the whole process through the use of a more highly perfected technique and more highly organized methods of procedure.

The analogy which we have just employed for the sake of clearness must not be pushed too far. We can draw a pretty sharp and definite line of distinction between the square and other rectangles. We cannot draw so sharp a distinction between the reasoning process and all other thinking. The distinction is one of the degree of difference in certain characteristics. There are all stages of development and refinement of the various elements of technique involved in the reasoning process, and there are all stages of development of skill in their use and of control over the process. It is, then, difficult to determine precisely what degree of development and perfection of the elements of technique is necessary and just how much skill in their use is requisite before we shall call the thinking process reasoning. In a broad sense *reasoning is controlled thinking.* If

we seek the specific differentia of the reasoning process which makes possible this superior control, we shall find two striking characteristics,—*the use of more perfect elements of technique and dependence upon laws and principles.* To the discussion of these two characteristics we must now turn.

2. Elements of Technique involved in Reasoning.

A large part of our discussion of the psychology of thinking has been concerned with the problem of analyzing and interpreting the various elements of technique involved in thinking. We have shown the conditions under which they are needed and their development is stimulated, and we have tried to interpret their function and significance in the life of the human organism. At this point we need, then, merely to summarize the results of previous discussions for the sake of emphasizing those elements of technique which are most characteristic of the reasoning process as distinguished from cruder forms of thinking.

(1) Imagination in general,—reproductive and constructive.

The constructive type of imagination is superior, because it uses free images, images not tied down to any particular setting and hence more movable and more capable of being brought together into new combinations. Also in constructive imagination elements of old images may be selected and recombined to make a new image symbolic of something which has not yet entered into experience. Thus essentials may be isolated and held before the mind in the attempt to apply the results of past experiences to new situations differing from any with which we have had to deal previously.

(2) The image,—concrete and abstract.

The abstract image is superior in its freedom, fluency, and power of symbolism.

(3) Association,—two types: (a) contiguous, or accidental, and (b) inherent, logical, or necessary.

The latter type is superior for the purpose of making sure connections of thought, independent of accidental contingencies, general in character, once available always available.

(4) The concept,—psychological and logical.

The latter is superior as a tool in the precise, definite, and reflective control of thought.

(5) Judgment,—implicit and explicit.

The latter is superior in making sure that connections of thought are right, through bringing out explicitly the grounds of inference.

(6) Induction and deduction.

Neither of these is to be regarded as superior for purposes of thought to the other. They are special and highly organized methods of controlling the thought process, the first in building up general notions and the second in applying them. They have their special devices, the hypothesis and the syllogism, which, in reasoning, contribute to definiteness and precision of control.

Summing up, we may say that the special elements of technique involved in reasoning are as follows: constructive imagination, the abstract image, logical, or inherent, association, the logical concept, explicit judgment, and an organized method of procedure either inductive or deductive, or both.

We have tried to formulate the psychology of thinking in terms of function rather than in terms of structure or of content. But function cannot be performed adequately to meet a variety of situations without characteristic differences of structure. These differences of structure which characterize reasoning as distinct from cruder forms of thinking are not, however, to be viewed as themselves primary. They are developments of form and of content that have come about in the process of gradually perfecting function.

3. Dependence of Reasoning upon Laws and Principles,—Empirical Thinking and Reasoning compared.

The second characteristic line of differentiation between reasoning and ordinary thinking is to be found in the larger amount of analysis involved and the greater dependence of the movement of thought upon the recognition of laws and principles. Perhaps this larger amount of analysis is itself only an aspect of the process of attempting to control the thinking by reference to laws. The situation needs to be analyzed more carefully in order to discover at just what point law is involved. The view of reasoning as thinking controlled by reference to laws and principles may be made clearer by entering upon a discussion of the difference between empirical thinking and reasoning.

(1) Illustrated in dealing with flickering gas flame.

Mr. James cites the case of trying to remedy a flickering gas flame by one who is not familiar with the principle in accordance with which gas burns.[1] Such a person might accidentally discover that by raising the chimney of the lamp a little at the bottom the flame burned more smoothly. Now, when he has difficulty with the flame again his remedy for the situation will be found through going back in memory and taking bodily the method of procedure which worked in the past and applying it to this situation. He will raise the chimney slightly and put something under it to hold it in that position. In so far as he has met the situation by thinking at all, this type of thinking would be called empirical. The situation confronting him has not been analyzed and the method of solution has been presented to consciousness through reproductive imagination. There has been little or no reconstruction. But suppose he had been familiar with some of the simplest laws of combustion. He would not have needed to experiment blindly in the first place to find a remedy. He would have immediately inferred that there was an insufficiency of oxygen, and that

[1] James, *Psychology,* Briefer Course, p. 359.

something must be done to provide a greater supply. On the basis of this inference, he would have raised the chimney slightly at once or have taken advantage of some device in the burner for supplying more air to the flame. His method of solution of the problem is determined by an analysis of the situation and the application of a law in accordance with which he constructs a method of procedure without experimentation or without previous experience in doing this particular thing.

(2) Illustrated in the procedure of medicine.

Empirical thinking is well illustrated in the procedure of early medicine. Certain herbs are found as the result of repeated experiences to be beneficial in certain kinds of sickness. When some one is ill, the illness is taken pretty much in the large as presenting a problem of a certain general type. This problem is solved by going back into past experience for the remedy. The remedy is taken as more or less of a ready-made affair, and it is applied in a series of steps the order of which is practically the same as that used on some previous occasion. There is no minute analysis of the problem nor of the remedy, and there is no careful and reflective adjustment of means to ends through thoroughgoing reconstruction of the mode of procedure to meet the specific conditions of the case in hand. The method of procedure is determined by a rule and not by the application of principles.

The trained physician of to-day approaches cases of sickness in a different way. Let us say that this case of sickness shows many superficial evidences of being a fever. But this does not immediately suggest a method of treatment taken bodily, or with little modification, from past experience. There are many different sorts of fever. Before prescribing for this case it must be analyzed more fully. It cannot be taken *en bloc*. Symptoms must be observed more carefully and inferences drawn from them. Furthermore, not all patients are exactly alike. The prob-

lem is quite different for people of different bodily conditions and of different temperaments. Before the physician can understand the exact nature and the degree of seriousness of the disease or of the kind and strength of the medicines he may use, he may have to make a thorough investigation of the present physical condition of the patient. Every vital organ may have to be examined. He may even have to go beyond this and seek information concerning his patient's heredity, his habits, and his manner of life in general. Before he can determine a mode of procedure which shall represent an adequate solution of his problem the physician must have a minute and detailed knowledge of his patient, of the chemical constituents of his medicines, of the structure and function of the various organs of the body, and of the specific effects of the properties of his medicines upon the action of the bodily organs. On the basis of his analysis of the whole given situation, taking account of all the elements of the problem and their relation to one another, he may construct a method of procedure specifically adapted to this particular case, even if he has never had a case just like it before. His method of procedure, his solution of the problem, is largely determined by his knowledge of laws and principles of human physiology and of the effects of drugs and other remedies upon the functions of the organs of the body. Of course, the scientific physician can never get completely away from certain empirical elements, nor can he fail to reap great advantages from abundance of experience; yet it is true in a sense that he virtually constructs anew his method of procedure for every case that he treats. He is a reasoner as distinguished from an empirical thinker.

(3) Illustrated in the procedure of agriculture.

In agriculture we see this same transition from empirical modes of dealing with its problems to scientific methods. The change is due to the formulation of laws and principles of plant growth, of the reactions of soils, etc. Again, along

with the formulation of laws and principles, there goes the recognition of the need of getting at the details of a situation. This makes problems specific and individual, while at the same time they fall under general principles. But, while general principles apply, the method of procedure must be worked out to suit the particular case. This process of attacking problems of agriculture not by rules of procedure determined wholly by past experience, but through the application of laws and principles to situations thoroughly analyzed, involves reasoning as over against empirical thinking. This will be made clearer in the illustrations which follow.

Farmers in many parts of the country once maintained the fertility of their soil by the rotation of crops. They plowed up grass land and planted it to corn or potatoes. The following year it was devoted to oats, and the next year it was sown to wheat. With the wheat, grass seed was sown, so that upon the harvesting of the wheat crop the land reverted to meadow once again. After taking off a few crops of hay, the rotation began once more. It was found that in this way better crops were produced than could be secured by raising the same crop upon the same field continuously. But the reason why the fertility of the soil was better maintained in this way was not known by many of those who followed the practice. The method of procedure was not constructed on the basis of a knowledge of underlying principles which made it valid. The same was true of the custom of plowing under green crops, such as clover and rye, and of the use of manure. The justification of these modes of procedure lay in their repeated success in previous experience as methods of maintaining the fertility of the soil. The methods were empirical rather than scientific; and the thinking involved in their use was empirical rather than reasoning. When the chemical nature of the soil has been accurately determined, the chemical constituents of various plants have been discovered, and

we know just what each crop takes from the soil and what it contributes to its enrichment, then it is possible reflectively to devise ways and means of adjusting crops to the soil and to one another in the agricultural process. In other words, the problems can be solved by reasoning; for exact knowledge of the essential factors entering into them can be secured, and laws and principles can be applied in the construction of methods of procedure.

4. Definition of Reasoning.

Having pointed out the specific differentia of the reasoning process, we are now ready to define reasoning from that point of view. *Reasoning is controlled thinking,—thinking organized and systematized according to laws and principles and carried on by the use of superior elements of technique.*

5. Biological Significance of Reasoning.

(1) Reasoning the highest factor of control.

The great problem of living creatures in their evolution from lower to higher forms is that of control over their environment. That form of control is most valuable in which the individual is able to manipulate elements of his environment in such a way as to make them serve as means to the realization of his own ends. The conscious processes are significant in the life of the organism on this very account. Reasoning is the culmination and summation of all the conscious processes in so far as they may be conceived as control phenomena. All thinking is essentially constructive in its nature. As it approaches that stage of development and organization which we call reasoning, it enables the individual to deal more and more effectively with new situations, thus enlarging and expanding his field of control over the world in which he lives. Furthermore, reasoning simplifies the process of solving the problems which confront the individual. Reasoning moves toward the solution of its problems in the most direct line. The

thinking process is guided and directed and safeguarded at every point. The process is methodized. There is consequently greater accuracy and adequacy in the performance of its function. In reasoning we have consciousness as the factor of variation and control of action realizing its function at the very highest level.

(2) Relation between reason and human freedom.

We may get at this same thought from a different angle by trying to state the relation between reasoning and will. Will is sometimes thought of as a separate faculty. In reality, will is only another name for the *fact of control* of action. This control of action has its basis in the motor, or impulsive, character of all consciousness. Every idea has in it a motor tendency, every thought is fraught with some sort of motor consequence either visible or invisible. In so far as any set of ideas can be brought into the focus of consciousness and held there by virtue of the nature and strength and number of the connections which have been set up between the various elements of the whole system to which it belongs, that set of ideas will determine action rather than some other set of ideas. *Will is only the guidance and direction of action or of thought by means of ideas.* From this point of view, will is not innate; it is an acquisition, *an achievement.* The tremendous output and expression of energy in a fit of anger is not will, because it is not free. It controls the individual instead of the individual controlling it. The same expenditure of energy put forth under the guidance and direction of ideas would be will. Freedom of the will is at its maximum where action is most fully under the guidance and direction of ideas. As reasoning gives the fullest and freest and most far-reaching kind of control over action, *human freedom,* if we do not like the term freedom of the will, *is achieved most completely where reason functions most fully.*

In our last statement we have come out at the same point at which Kant arrived when he made the possibility of all morality rest upon human freedom and conceived of human freedom as inherent only in reason. But we have arrived at the same thought as Kant without the necessity of thinking of reason as something apart from the rest of the conscious life and likely to be vitiated and contaminated if it had any connection with impulse and feeling. From the biological and functional point of view we cannot conceive of any conscious process which is not dynamically related to all the other conscious processes and to the life of action. It is because of this fact that reason can control impulse, action, and thought and man can be free. It is through the evolution of the power of reasoning that man has risen to his high level of a free moral agent. Through this power he has become not only a creature who exercises more fully than all others the power of controlling his environment to meet the exigencies of his own individual life, but also he has achieved the power of determining within certain limits his own self, of controlling his own character. To work out the biological significance of this would carry us far over into the fields of ethics and sociology. But it needs no extended argument to enable those who have followed the line of thought which is central in this book to see that the development of the ethical and social consciousness in its more reflective form, made possible through reasoning, is of immense biological significance.

6. The Question of the Reasoning of Animals.

Now that we have worked out the specific differentia of reasoning, we are able to attack the question so often asked, "Do animals reason?" One class of writers is very strong in the assertion of the negative of this question, and another is just as strong in the assertion of the positive. In both cases there is usually a confusion arising from the

failure to analyze exactly what is meant by reasoning. If we mean by reasoning the power to think by means of abstract images, logical concepts, and other highly developed elements of technique in the thinking process, and still further if we include the organization of the thinking process into modes of procedure dominated by laws and principles, then we shall have to say that animals do not reason. But this is not saying that they do not think. It still may be that on the basis of crude memory processes and vague imagery animals do actually vary their modes of procedure to better adjust means to ends in situations the nature of which they dimly recognize and appreciate.

It is very doubtful whether any cases of animal intelligence can be found in which the supposition of reasoning is necessary to their explanation; but in these same cases it might be very difficult to account for the facts without presupposing some sort of thinking process. The writer himself inclines to the view that animals do not reason, but that they may and do think, the extent of their thinking, however, being very much less than the lovers of animal pets or the writers of animal stories usually suppose. Before passing judgment upon any case of animal intelligence, it is necessary to know its complete background and setting. We must take account very carefully of the specific instincts of the species and of the nature and length of any learning process which has been involved. The cleverest performances of animals, often regarded as exhibitions of thinking, may be the result of a very long period of learning or of training during which firm associations have been set up between certain signs and certain acts. The only factor of consciousness necessary to their explanation may be associative memory, a type of memory which is far more organic than intellectual in character.

We are on pretty safe ground when we are quite skeptical regarding apparent cases of animal thinking, yet from the evolutionary point of view there seems to be no

reason why one should be so determined to interpret every act of the lower animals on the basis of automatism as some scientists are. Why not grant that the conscious processes which attain their highest development in the human race have their roots far back in animal life? This seems more consistent than the contrary with the general theory of evolution. Biologically, consciousness is the great factor of variation of responses to meet the needs of individuals as distinct from those of species. We find considerable variation of response in foxes, dogs, horses, monkeys, etc., and in many of the birds. It is entirely problematic how much development of consciousness we need to assume in order to explain the facts. It seems clear that we do not find variations of the sort that make necessary the assumption of reasoning; it is not so clear that we do not need to assume some crude form of thinking.

7. The Question of the Reasoning of Children.

This topic has been discussed in an earlier chapter. There it was held that we need to distinguish carefully between reasoning and ordinary thinking. The general line of distinction was pointed out. Now that the meaning of reasoning has been cleared up by an elaborate discussion of its specific differentia, the discussion of the thinking of the child ought to be more intelligible.

It is evident that the child does not very early make use of the elaborate and highly specialized technique of thinking which justifies us in calling it a reasoning process. This technique is developed in the process of experience to meet the needs of the thinking function more adequately, and not until it has been sufficiently developed and brought under control can the child reason. To infer, however, that because the child does not reason therefore he cannot think is not legitimate. He does organize his crude conscious processes in such a way as to deal satisfactorily with certain kinds of problems whose nature demands thinking,

principally those which are quite concrete and relatively simple. The child is not merely receptive, his mental processes are constructive to some extent at a very early age. Consequently he ought to be given school exercises which make demands upon his rudimentary thinking power.

8. Training in Reasoning.

(1) Reasoning the remote goal.

The power to reason ought to be regarded as the remote goal in the early stages of education. It is the finished product which should be the outcome of a long period of development and training. In this case, as in many others, the quickest way to reach the goal is not to aim directly at it. Such a course of procedure may only result in arrested development.

(2) Stages of progress in attainment of the goal.

The psychology of thinking which we have worked out recognizes the continuity of development of the thinking process from its crudest beginnings in the differentiation of the imagination up to its highest development in the reasoning process of the most highly trained and educated man. At the same time, we have emphasized certain characteristic phases of development. While no exact time can be assigned to them, and while they cannot be sharply separated from one another, yet there is an order of development, and the stress of training should vary with the dominant characteristics of different periods.

There seem to be about three phases in the development of the thinking process. These three phases we have seen to be (1) the rapid development of the imagination; (2) the conscious distinction within the imagination between means and ends; and (3) the wider appreciation of laws and principles. The first period of development corresponds roughly to that of the kindergarten and the first two grades. The training of thinking in this period should concern itself largely with the task of laying the foundation

of a rich background of first-hand experiences which shall yield the concrete images on which all interpretation ultimately rests. The second period corresponds roughly to that of the elementary school from the third grade to the eighth. With the development of the conscious distinction between means and ends, there should go training in the solving of problems in which the relation of means to ends is worked out within concrete wholes. The child of the grades should not so much study physics as typical problems in physics; history, as specific, typical, concrete problems, etc. The relations between cause and effect, conditions and consequences, means and ends should first be seen frequently within definite concrete wholes. The interest in broad generalizations cannot be genuine and deep until the habit of mind is first developed of looking for the embodiment of principles within narrower compass. The third period corresponds roughly to that of the high school and the college. In the period of adolescence there develops the larger interest in generalizations as such. This then is the time rather than in the grades for the organization of subject matter in the more logical form of distinct sciences. In the matter of training to think, more stress may now be thrown upon the elements of technique and organization that are characteristic of reasoning.

(3) Relation between function and technique in training. If reasoning is a finished product of training, then analysis of this finished product cannot determine the standard by which we shall judge the thinking of the child. Neither can it lay down the rules which determine the kind of exercises which are most valuable for him as training in the power to think. Yet a knowledge of the finished product is necessary to the teacher; for every exercise, or set of exercises, employed in the training of the child to think must be brought to the test of the question, "Does it further the development of those characteristics which ultimately lead over into the power to reason?" But this

is after all of relatively little importance as compared with the question, "Does this exercise, or course of exercises, give the child practice in a normal fashion in the solution of real problems?" We are less likely to misplace the emphasis in early training if we center attention upon the performance of function rather than upon the question of form and technique.

The functional point of view rather than the structural is the richer in suggestions for educational theory and practice. It reveals the thinking process to us in its setting and gives us an appreciation of its dynamic nature. From this point of view we can rightly interpret the significance and value of the various elements of structure, or of technique, that are involved. We are not so likely to set them up as ends in the process of training, but we shall conceive them more clearly as valuable tools which are needed for the more adequate performance of a useful function. Training in the elements of technique necessary to the reasoning process will thus not be ignored, but it will be given its proper place. It will conform to the principle,—exercise of the function first, then practice in the perfection of the technique necessary to the more perfect realization of the function. Training in technique is useless unless the time for the use of the technique has come, and that is the time when its need is felt.

Training in thinking cannot be dominated at every point by methods derived from the analysis of the finished product reasoning, neither can it be regarded as complete unless it arrives at the goal of the finished product. It must culminate in the development of the power on the part of pupils in the high school and the college to think in terms of the most efficient tools which the human race has perfected in its attempt to control the world in which it lives. Only thus can they achieve that freedom which is essential to the fullest realization of the individual self and which makes man the noblest work of God.

SUMMARY OF REFERENCES

Angell, *Psychology.*

Angell, *The Province of Functional Psychology,* Psy. Rev., March, 1907.

Bagley, *The Educative Process.*

Baldwin, *Mental Development.*

Bolton, *Meaning as Adjustment,* Psy. Rev., May, 1908.

Butler, *Meaning of Education.*

Calkins, *Introduction to Psychology.*

Chamberlain, *The Child.*

Dewey, *Psychology.*

Dewey, *The Child and the Curriculum.*

Dewey, *Psychology and Social Practice.*

Dewey, *The School and Society.*

Dopp, *The Place of Industries in Elementary Education.*

Fiske, *Excursions of an Evolutionist.*

Fiske, *Outlines of Cosmic Philosophy.*

Groos, *The Play of Animals.*

Groos, *The Play of Man.*

Horne, *The Philosophy of Education.*

James, *Psychology,* Briefer Course.

James, *Talks to Teachers.*

King, *Psychology of Child Development.*

Kirkpatrick, *Fundamentals of Child Study.*

McMurry, *Elements of General Method.*

McMurry, *Method of the Recitation.*

O'Shea, *Education as Adjustment.*

O'Shea, *Dynamic Factors in Education.*

Stout, *Manual of Psychology.*

Sully, *Studies of Childhood.*

Sully, *Teacher's Handbook of Psychology.*

Titchener, *An Outline of Psychology.*

Welton, *Logical Bases of Education.*

INDEX

NOTE.—Names of authors to whose works specific references have been given are not included in this index. For these, see references at end of chapters. Topics in the index have been analyzed very little where material is more or less continuous, because the subject matter of the text is quite closely analyzed and sub-topics can be traced very easily there or in the table of contents.

Rational Living. Some Practical Inferences from Modern Psychology. By HENRY CHURCHILL KING, President of Oberlin College. New York, 1905. *Cloth. 271 pages. 12mo. $1.25 net.*

The Psychology of Socialism. By GUSTAVE LE BON. New York, 1899. *Cloth. 415 pages. 8vo. $3.00 net.*

The Crowd. A Story of the Popular Mind. By GUSTAVE LE BON. London, 1903. *Cloth. 239 pages. 12mo. $1.50 net.*

Psychology of the Moral Self By B. BOSANQUET. London, 1897. *Cloth. 132 pages. 12mo. $1.25 net.*

Introduction to Physiological Psychology. By Dr. THEODOR ZIEHEN, Professor in Jena. Translated by C. C. VAN LIEW, and OTTO W. BEYER. Illustrated. London, First Edition, 1892; Third Edition, 1899.
Cloth. 305 pages. 12mo. $1.50 net.

Principles of Physiological Psychology. By WILHELM WUNDT, Professor of Philosophy in the University of Leipzig. Translated from the Fifth German Edition (1902) by EDWARD BRADFORD TITCHENER, Sage Professor of Psychology in the Cornell University. London, 1904.
Volume I. Introduction. Part I: The Bodily Substrate of the Mental Life. Illustrated.
Cloth. 347 pages. 8vo. $3.00 net.

Lectures on Human and Animal Psychology. By WILHELM WUNDT, Professor of Philosophy at the University of Leipzig. Translated from the German by J. E. CREIGHTON and E. B. TITCHENER. London, First Edition, 1894; Second Edition, 1896; Third Edition, 1901. *Cloth. 459 pages 8vo. $2.60 net.*

Social Psychology. By EDWARD A. ROSS, Professor of Sociology in the University of Wisconsin. New York, First Edition, 1908. *Cloth. 372 pages. 12mo. $1.50 net.*
